आज़ादी का अमृत महोत्सव

G20 भारत 2023 INDIA

INTERNATIONAL YEAR OF MILLETS 2023

वार्षिक प्रतिवेदन

ANNUAL REPORT

2023

भा.कृ.अनु.प. – भारतीय सोयाबीन अनुसंधान संस्थान

ICAR – Indian Institute of Soybean Research

ISO 9001 2015 Certified Organization

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Preface

Soybean, as a major contributor to the total oilseeds and edible oil production in the country, plays a crucial role in reducing edible oil imports and supporting various industries by providing raw materials. It's noteworthy that a record 14.9 million tons of soybeans were produced in India during 2022. However, the 2023-24 crop season faced variable weather conditions, with continuous rains in July hampering initial growth and a prolonged dry spell in August 2023 further affecting the yield. To meet present and future demand, there is a pressing need to significantly increase soybean productivity. Addressing the challenges of climate variability-related biotic and abiotic stress and enhancing soybean crop productivity are key concerns for soybean researchers. The ICAR-Indian Institute of Soybean Research is actively working to tackle these challenges by developing high-yielding, trait-specific varieties that are tolerant to biotic and abiotic stress. The institute aims to achieve this by increasing the cultivation of newly released varieties through quality seed production and developing sustainable crop production systems. In 2023, three soybean varieties: NRC 165, NRC 181, and NRC 188 were identified for release, while five varieties; NRC 131, NRC 136, NRC 150, NRC 152, and NRC 157 were notified for cultivation. Notably, NRC 188 is the first vegetable soybean variety identified for central India. New breeding lines of vegetable-type soybean with good germination and sweet taste were identified. Anthracnose disease-resistant germplasm was identified using the pod inoculation method, and genotypes showing antixenosis against *Spodoptera* were also identified. New germplasm accessions of *Glycine max* and *Glycine soja* were procured from USDA via ICAR-NBPGR. Genome-wide association studies have identified crucial genomic loci associated with anthracnose resistance and root traits. Genotypes resistant to yellow mosaic disease and with high oil content have been successfully bred. The institute has made significant progress in characterizing *Rhizoctonia solani* isolates causing RAB disease. Implementing permanent broad bed furrows with residue retention has shown improved soybean yield and enhanced economics of soybean-based cropping systems. A microbial consortium (*Bacillus aryabhattai* + *Bradyrhizobium lioningense* + AMF) has been identified for significantly improving the seed yield of soybean and wheat. Application of the phytohormone Tria 2ppm with AM inoculation showed higher nodule biomass, leghemoglobin content in nodules, and soybean seed yield. In 2023, the institute embraced various initiatives, including natural farming, pre-breeding for the introgression of novel traits from *G. soja,* breeding for vegetable-type soybean, genome editing for biotic stress and quality traits, and speed breeding by raising two extra generations during rabi and summer seasons.

I express my gratitude to Dr. Himanshu Pathak, Secretary, DARE and Director-General, ICAR, for their guidance and consistent support in soybean research and development. I also extend my deep sense of gratitude to Dr. T. R. Sharma, Deputy Director General (Crop Science), for his constant mentoring, support, and guidance in planning and executing various research activities at the institute. My heartfelt appreciation goes to the Chairman and members of RAC for their invaluable guidance in strategic research planning. Special thanks are extended to Dr. Sanjeev Gupta, ADG (Oilseed and Pulses), ICAR, New Delhi, for his valuable contributions to the progress of the Institute. Additionally, I would like to acknowledge the editorial committee for their diligent efforts in making this report comprehensive and informative. I trust that this Annual Report will prove valuable to researchers, policymakers, farmers, industries, and development functionaries involved in promoting soybean research and development.

IISR, Indore
February 1, 2024

(K. H. Singh)
Director

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- एन.आर.सी. 181, के.टी.आई. से मुक्त एक शीघ्र परिपक्वता वाली किस्म को मध्य क्षेत्र में खेती के लिए जारी किया गया। मध्य भारत की पहली सब्जी सोयाबीन किस्म, एन.आर. सी.188, मध्य क्षेत्र में खेती के लिए जारी की गई। एन.आर.सी. 197, एक शीघ्र परिपक्वता एवं के.टी.आई. मुक्त जीनोटाइप को नार्थ हिल जोन में ए.वी.टी. में पदोन्नत किया गया। एन.आर. सी.258, एक उच्च तेल वाली जीनोटाइप को मध्य क्षेत्र में ए.वी. टी. में पदोन्नत किया गया।

- सयुंक्त राज्य अमेरिका कृषि विभाग से प्राप्त *ग्लाइसिन मैक्स* की 475 नये जर्मप्लाज्म परिग्रहण और *ग्लाइसिन सोजा* की 168 जर्मप्लाज्म परिग्रहण को संगरोध से मंजूरी के बाद आईसीएआर-एनबीपीजीआर से प्राप्त की गईं है। संस्थान के मध्यावधि भंडारण में कुल 6221 जर्मप्लाज्म परिग्रहण का रखरखाव किया जा रहा है। आई.सी.ए.आर-आई.आई.एस.आर. इंदौर में उपलब्ध सोयाबीन परिग्रहण की स्थिति के लिए जर्मप्लाज्म स्थिति सूचना प्रणाली का प्रारंभिक प्रोटोटाइप विकसित किया गया है। संस्थान द्वारा ए.आई.सी.आर.पी.एस. के 25 संस्थानों और 7 केंद्रों को कुल 3937 जर्मप्लाज्म परिग्रहण वितरित किए गए।

- एस.एल.958 *(ई1, ई2, ई3, ई4)* की चौबीस निकट आइसोजेनिक लाइनों (NILs) का मूल्यांकन 6 चेक के साथ किया गया। चार NILs अर्थात एन.आर.सी.225, एन.आर.सी.229, एन.आर.सी.230 और एन.आर.सी.249 ने सर्वोत्तम चेक (जे.एस.20-34) से 15-49% तक अधिक अनाज प्राप्त किया। अनुक्रमण द्वारा लंबे किशोरअवस्था एलील *j* की उपस्थिति के लिए जर्मप्लाज्म परिग्रहण वी 61 की पुष्टि की गई, और मार्कर की सहायता से चयन के लिए पी.सी.आर. आधारित मार्कर विकसित किए गए। गुणात्मक और मात्रात्मक लक्षणों के लिए प्रक्षेत्र की स्थिति में पच्चीस *ग्लाइसीन सोजा* परिग्रहण की विशेषता जांची गई।

- अट्ठाईस 4-वे क्रास से प्राप्त उन्नत प्रजनन आबादी का प्रारंभिक रूप से उपज के साथ-साथ सुखा सहनशीलता गुणों के लिए मूल्यांकन किया गया। तीन पंक्तियाँ अर्थात. एम-51-2-6, एम-22-26 और एम-54-4ए-8 ने क्रमशः 55.2, 45.1 और 38.8 प्रतिशत स्टेम रिजर्व जुटाव के संदर्भ में उच्च शुष्कन

Executive Summary

- Three varieties of soybean; NRC 165, NRC 181 and NRC 188, were identified for release during annual group meeting of AICRP on Soybean, and five varieties; NRC 131, NRC 136, NRC 150, NRC 152 and NRC 157 were notified for cultivation.Two long juvenile varieties NRC 157 and NRC 131, and a drought tolerant variety NRC 136, were notified for Madhya Pradesh state. NRC 165, an early maturing variety, was identified for release in Central Zone. One entry (NRC 262) registered 23% yield advantage over the best check in IVT (early maturity) in AICRP trials and promoted to AVT I.

- NRC 181, an early maturing genotype free from KTI was released for cultivation in Central Zone. NRC 188, the first vegetable soybean variety of central India, was released for cultivation in Central Zone. NRC 197, an early maturing KTI free genotype was promoted to AVT II in North Hill Zone. NRC 258, a high oil genotype was promoted to AVT I in Central Zone.

- Four hundred seventy five new accessions of *Glycine max* and 168 new accessions of *Glycine soja* procured from USDA were obtained from ICAR-NBPGR after clearance from quarantine. A total of 6221 germplasm accessions are being maintained in mid-term storage of ICAR-IISR, Indore. Preliminary prototype of Germplasm Status Information System was developed to maintain the status of soybean accessions available at ICAR-IISR, Indore. A total of 3937 germplasm accessions were distributed to 25 institutes and 7 centres of AICRP soybean.

- Twenty four Near Isogenic Lines of SL 958 (*e1, e2, e3, e4*) were evaluated with 6 checks. Four NILs viz NRC 225, NRC 229, NRC 230 and NRC 249 out yielded the best check (JS 20-34) by 15-49%. Germplasm accession V 61 was confirmed for presence of long juvenile allele *j* by sequencing, and PCR based markers were developed for marker assisted selection. Twenty five *Glycine soja* accessions were characterized in field condition for qualitative and quantitative traits.

- Advanced breeding population (F_7: 124 lines) derived from twenty-eight 4-ways crosses were evaluated for yield as well as desiccation tolerance traits. Three lines viz. M-51-2-6, M-22-26 and M-54-4A-8 showed high desiccation tolerance in terms of 55.2, 45.1 and 38.8 per cent stem reserve mobilization, respectively.

सहनशीलता दिखाई। एन.आर.सी.190, क्रॉस जे.एस.97-52 जे.एस.355 से प्राप्त एक उच्च उपज वाली सूखा सहिष्णु प्रविष्टि, उत्तर पूर्वी पहाड़ी क्षेत्र में आई.वी.टी.-2023 परीक्षण में लगातार तीसरे वर्ष दोहराई गई है।

- हाइड्रोपोनिक कल्चर का उपयोग करके तीन सप्ताह के चरण में विभिन्न जड़ लक्षणों के लिए 234 परिग्रहणों का एक जर्मप्लाज्म सेट फेनोटाइप किया गया था। कुल 234 जीनोटाइप में जड़ लक्षण फेनोटाइपिंग डेटा के साथ एस.एन.पी. मार्करों के जीनोम वाइड एसोसिएशन विश्लेषण ने प्राथमिक जड़ लंबाई, कुल जड़ लंबाई, जड़ मात्रा, सतह क्षेत्र और जड़ युक्तियों से जुड़े महत्वपूर्ण SNP की पहचान की। सात *SOR1-जैसे* जीनों के जीन अभिव्यक्ति विश्लेषण से आठ विपरीत जीनोटाइप में दो जीनों, *Glyma-01g097900* और *Glyma-06g091651* की अन्तर अभिव्यक्ति का पता चला।

- एम.ए.एस. का उपयोग करके विकसित पीला मोजेक रोग प्रतिरोधी और उच्च तेल प्रविष्टि एन.आर.सी.259 को मध्य क्षेत्र में ए.वी.टी.1 में पदोन्नत किया गया है। पोड-इनोक्यूलेशन विधि का उपयोग करके मूल्यांकन के अनुसार एन्थ्रेक्नोज (सबसे विषैले आइसोलेट- महू आइसोलेट के खिलाफ) के लिए सात जीनोटाइप अर्थात एन.आर.सी.130, एन.बी.208, ए.जी.एस. 163 ए, एन.आर.सी.202, एन.आर.सी.152, ई.सी.34106 और सी.ए.टी. 1504 प्रतिरोधी पाए गए। जे.एस.335 की पृष्ठभूमि में दाता के रूप में *ग्लाइसिन सोजा* का उपयोग करके विकसित जीनोटाइप, एन.आर.सी.एस.एल.8 (आई.एन.जी.आर. 23101), ने कई प्रमुख बीमारियों के खिलाफ प्रतिरोधी प्रतिक्रिया दर्शाई, जिसको आई.सी.ए.आर-एन.बी.पी.जी.आर, नई दिल्ली में पंजीकृत किया गया।

- भारत के विभिन्न सोयाबीन उत्पादक क्षेत्रों से *राइजोक्टोनिया* एरियल झुलसा रोग पैदा करने वाले कुल 42 *राइजोक्टोनिया सोलानी* के आइसोलेट्स एकत्र किए गए। रेडियल वृद्धि के आधार पर, आर.एस.3 (सीहोर), आर.एस.34 (बिंदुखट्टा), आर.एस.35 (कमलावागांजा) तेजी से बढ़ने वाले आइसोलेट्स थे, जबकि आर.एस.21 (होशंगाबाद), आर.एस.22 (खरगोन) और आर.एस.39 धीमी गति से बढ़ने वाले आइसोलेट्स पाए गए।

- *स्पोडोप्टेरा लिटुरा* के खिलाफ काले सोयाबीन जीनोटाइप ई.सी.1039028 ने मजबूत एंटीक्सेनोसिस एवं 4 जीनोटाइप्स, जे.एस. (एस.एच.) 131, ई.सी.589407, ए.जी.एस.160 और आई.सी.24997,ने मध्यम एंटीक्सेनोसिस प्रदर्शित किया। स्टेम फ्लाई के 50 नर और 50 मादा दोनों के लिए अलग-अलग शारीरिक वाष्पशील पदार्थों को डायथाइल ईथर का उपयोग करके एकत्र किया गया। पांच जीनोटाइप जैसे कि, F4P21, F3P18, CAT2503, JS 9560 और JS 335 के पत्ती वाष्पशील पदार्थों का उपयोग करके ओलफैक्टोमीटर बायो से, जी.सी. - एम.एस. विश्लेषण और इलेक्ट्रोफिजियोलोजी अध्ययन किया गया ।

- अवशेष प्रतिधारण के साथ स्थायी चौड़ी नाली से खरीफ (सोयाबीन में 17.5% अधिक उपज) और रबी फसलों की उपज और अर्थव्यवस्था में सुधार पाया गया। सोयाबीन आधारित फसल प्रणाली के तहत अवशेष प्रतिधारण के बिना जुताई से

NRC 190, a high yielding drought tolerant entry derived from a cross JS 97-52 x JS 355, is repeated third year in a row in IVT-2023 trial in North Eastern Hill Zone.

- A germplasm set of 234 accessions was phenotyped for various root traits at three-weeks stage using hydroponic culture. Genome wide association analysis of SNP markers with root traits phenotyping data in 234 genotypes identified significant loci associated with primary root length, total root length, root volume, surface area and root tips. Gene expression analysis of seven *SOR1-likes* genes revealed differential expression of two genes, *Glyma.01g097900* and *Glyma.06g091651,* in eight contrasting genotypes.

- YMV resistant and high oil entry NRC 259, developed using MAS has been promoted to AVT 1 in Central Zone. Seven genotypes viz., NRC 130, NB 208, AGS 163A, NRC 202, NRC 152, EC 34106 and CAT 1504 were found to be resistant for anthracnose (against the most virulent isolate- MHOW isolate) as evaluated using pod-inoculation method. NRCSL 8 (INGR23101), a genotype developed using *Glycine soja* as donor in the background of JS 335, expressed resistant reaction against multiple key diseases.It was registered with ICAR-NBPGR, New Delhi.

- A total of 42 *Rhizoctonia solani* isolates causing RAB disease were collected from different soybean growing regions of India. Based on radial growth, RS3 (Sehore), RS34 (Bindukhatta), RS35 (Kamlawaganja) were fast growing isolates, whereas, RS21 (Hoshangabad), RS22 (Khargone) and RS39 were found to be slow growing.

- Black soybean genotype EC 1039028 exhibited strong antixenosis whereas 4 genotypes Viz., JS (SH) 131, EC 589407, AGS 160 and IC 24997 exhibited moderate antixenosis against *Spodoptera litura*.Body volatiles of stemfly for both, 50 males and 50 females, were collected separately by using diethyl ether as solvent.Olfactometer bioassay, GC-MS analysis and electrophysiology studies were done using leaf volatiles of five genotypes viz., F4P21, F3P18, CAT2503, JS 9560 and JS 335.

- Permanent broad bed furrow with residue retention improved yield and economics of *kharif* (17.5% higher yield in soybean) and *rabi* crops [12.4% higher yield in wheat 38.8% in potato, 44.6% in wheat after potato and 16.6% in chickpea over conventional

पारंपरिक की तुलना में गेहूं में 12.4% अधिक उपज, आलू में 38.8%, आलू के बाद गेहूं में 44.6% और चने में 16.6% अधिक उपज प्राप्त हुई। सोयाबीन आधारित फसल प्रणालियों के तहत प्राकृतिक कृषि पद्धतियों को मानकीत करने के लिए प्रयोग शुरू किए गए हैं।

- माइक्रोबियल कंसोर्टिया *(बैसिलस आर्यभट्टकई + ब्रैडिरहिजोबियम लियोनिंगेंस + ए.एम.एफ.)* के उपयोग से मिट्टी में पोषक तत्वों की मात्रा और उपभोग में सुधार करके सोयाबीन और गेहूं की बीज उपज में काफी सुधार पाया गया। ए.एम.एफ. + *बी.आर्बोरिस* + ब्र. (20.51 मिलीग्राम / पौधा) के साथ बीज टीकाकरण ने ए.एम.एफ. + *बी.आर्बोरिस* + ट्राइया (18.77 मिलीग्राम/ पौधा) पौधों की तुलना में अधिक जड़ बायोमास का उत्पादन किया। एएम टीकाकरण के साथ फाइटोहोर्मोन्स ट्राइया 2पीपीएम में नोड्यूल बायोमास, नोड्यूल्स में लेगहीमोग्लोबिन और सोयाबीन बीज उपज में काफी अधिक पाया गया।

- विभिन्न किस्मों जैसे एन.आर.सी.142, एन.आर.सी.138, एन.आर.सी.130, एन.आर.सी.128, एन.आर.सी.136, एन.आर.सी.86 और आर.वी.एस.24 के सोयाबीन ब्रीडर बीज का उत्पादन ए.आई.सी.आर.पी. बीज (फसल) के तहत किया गया जिससे 620 क्विंटल ब्रीडर बीज का उत्पादन हुआ। इंदौर और उज्जैन के प्रगतिशील किसानों के सहयोग से बीज हब परियोजना के तहत एन.आर.सी.142, एन.आर.सी.130, एन.आर.सी.138 और जे.एस.20-69 के लिए फाउंडेशन, प्रमाणित और टीएल श्रेणियों का बीज उत्पादन शुरू किया गया और कुल 773 क्विंटल बीज का उत्पादन हुआ।

- आई.सी.टी. पहल के तहत, संस्थान छह सोशल मीडिया का उपयोग कर रहा है। सोयाबीन उत्पादन और उपयोग के विभिन्न पहलुओं पर सोशल मीडिया पर कुल 214 वीडियो अपलोड किए गए। 'राष्ट्रीय किसान दिवस' के अवसर पर 'सोयाबीन बीज दिवस' का आयोजन किया गया, जिसमें 1200 से अधिक किसानों ने भाग लिया और नई किस्मों के 1300 बीज पैकेट वितरित किए गए। संस्थान ने अनुसूचित जाति उपयोजना (एस.सी.एस.पी.) के तहत किसान प्रशिक्षण और इनपुट वितरण कार्यक्रम आयोजित किए जिसमें मध्य प्रदेश के कुल 2375 किसान लाभान्वित हुए।

tillage without residue retention] under soybean based cropping system. Experiments have been initiated to standardize natural farming practices under soybean based cropping systems.

- Microbial consortia *(Bacillus aryabhattai + Bradyrhizobium lioningense* +AMF) significantly improved seed yield of soybean and wheat by improving nutrient uptake and content in soil over control. Seed inoculation with AMF + *B. arboris* + Br. (20.51mg^{-1} plant) produced more root biomass than to AMF + *B. arboris* + Tria (18.77 mg^{-1}plant) plants. Among phytohormones Tria 2 ppm with AM inoculation found significantly higher nodule biomass, leghemoglobin content in nodules and soybean seed yield.

- Soybean breeder seed production of different varieties viz., NRC 142, NRC 138, NRC 130, NRC 128, NRC 136, NRC 86 and RVS 24, was undertaken under AICRP Seed (Crop) producing 620 quintal of breeder seed. Seed production of Foundation, Certified and TL classes for NRC 142, NRC 130, NRC 138 and JS 20-69 was taken up under Seed Hub Project in collaboration with progressive farmers of Indore and Ujjain, and total of 773 quintal seed was produced.

- Under the ICT initiatives, the institute is making use of six social media platforms. A total of 214 videos were uploaded in social media on different aspects of soybean production and utilization. 'Soybean Seed Day' was organized on the occasion of 'Rashtriya Kisan Diwas' in which more than 1200 farmers participated and 1300 seed packets of newly release varieties were distributed. Institute organized farmers training and input distribution programmes under Schedule Caste Sub Plan (SCSP) scheme benefiting 2375 farmers of the Madhya Pradesh.

2. Introduction

Indian Council of Agricultural Research (ICAR) has established the ICAR-Indian Institute of Soybean Research (IISR) in the year 1987 at Indore in the State of Madhya Pradesh to take up the centralized research to support soybean production systems with basic information and breeding material. Coordinating unit of All India Coordinated Research Project on Soybean (AICRPS), Soybean Breeder Seed Production (SBSP) and National Active Germplasm Site (NAGS) for soybean germplasm are also situated at ICAR-IISR, Indore. The research plan and policies of ICAR-IISR are guided by the recommendations of the Research Advisory Committee (RAC), Quinquennial Review Team (QRT) and the Institute Research Council (IRC). The Institute Management Committee (IMC) supports implementation of its plans and programs. Institute had also setup an Agribusiness Incubation Centre (ABI) for training and support of start-ups in the area of soybean food processing and production technologies.

Physiography

ICAR-IISR campus is located in the village Piplyarao of district Indore in Madhya Pradesh state, which lies in Vidhyanchal range of Malwa Plateau at 22° 4'37"N latitude and 75° 52'7"E longitude. It is positioned at an altitude of 550 meter above the mean sea level. The institute has an area of 58.05 hectares with 42.7 ha cultivable land for research and seed production. ICAR-IISR is situated at a distance of 12Km from Devi Ahilya Bai Holkar International Airport, Indore and 6 Km from railway station, Indore.

Soil

The soil of ICAR-IISR research farm is deep black cotton soil with pH 7.6 to 8.1 (basic / alkaline), low to medium in organic carbon, available phosphorus, and high in potassium. Taxonomically it is classified as fine, montomorillonitic, hyperthermic family of typicchromusterts and fine clay loam, montmorillonitic family of lithic verticustochrepts.

Climate

The climate of the *Malwa* Plateau of Madhya Pradesh is semi arid with a growing period of 150-180 days. As such, the climate of this region is characterized by 3 distinct agricultural seasons. Those are: (a) rainy season, also known as monsoon or *kharif*, usually begins from mid-June and extends up to early October. Generally, duration of monsoon is approximately 98 days with about 800 mm mean annual rainfall and soybean is grown during this season as a rainfed crop. (b) post-rainy season which runs from mid-October to March, also known as *rabi*, is dry and cool and, (c) warm and dry season, which begins in February and lasts until April called *zaid* or summer/spring and any crop grown during this season requires irrigation.

Past achievements

Major achievements of the institute includes maintenance of a vast collection of soybean germplasm comprising exotic, indigenous, breeding lines and wild species. Currently, 6221 germplasm accessions are maintained at ICAR-IISR. A number of genetic resources have been identified for various traits like photoperiod insensitivity, long juvenility, drought and waterlogging tolerance, heat stress tolerance and resistance to diseases such as charcoal rot, anthracnose, rust and yellow mosaic and some insects. Twenty high yielding varieties having resistance to various biotic and abiotic stresses and food grade characters have been bred by Institute and released for cultivation in different agro-ecological regions of the country. First null KTI genotype in the country, NRC 127, has been released for cultivation in the Central Zone. NRC 142, a high yielding variety free from KTI and Lipoxygenase 2, has been released for Central and Southern Zone. First high oleic acid variety NRC 147, has been released for cultivation in Eastern and Southern Zone. Four germplasm accessions EC 390977, EC 34101, JS 20-34 and MACS 330 having photoperiodic genes and early maturity traits, EC34372 having anthracnose resistance, AGS 25 having long juvenile trait and JS 20-38 having water logging traits tolerance have been registered at ICAR-NBPGR, New Delhi. Molecular markers have been identified for maturity, 100-seed weight and yellow mosaic disease resistance traits.

In the field of crop production, *in situ* moisture conservation technology and the associated

mechanization for soybean-based cropping system (BBF, FIRBS, R&F, Subsoiler) have been developed and commercialized. Remunerative soybean based intercropping systems (Soybean + Pigeonpea, Soybean+Maize and Soybean + Sugarcane) with suitable cultivars under soybean + sugarcane intercropping were identified. Integrated nutrient and weed management for soybean based cropping system have been developed. Soil health enhancing microbes including Zn, Fe solubilizing bacteria and native rhizobia have been identified.Foliar application of Thiourea was recommended to alleviate drought stress in soybean. Microbial consortia (*Bradyrhizobium daqingense* + *Bacillus aryabhatii)* was identified to save 25% of Nitrogen & Phosphorous fertilizers in soybean.

In the area of plant protection, integrated management schedule for major soybean insect pests have been worked out. Studies on epidemiology of rust occurrence in soybean revealed that the source of rust inoculum for south India lies in the Krishna valley. The economic benefit of adoption of rust resistant varieties in rust prone districts of Maharashtra and Karnataka states were estimated which showed that widespread adoption of rust resistant varieties significantly contributed to farm income and crop stabilization in the region.

Web-based expert systems for varietal and disease identification and data management systems for AICRPS have been developed. Soybean Gyan - a mobile app for soybean farmers, developed by the institute, provides information on different aspect of cultivation viz., agronomic package of practices, insect and disease management etc. It also gives information about selection of suitable varieties; seed treatment, seed rate and seed storage.

Consequently, the institute has emerged as a catalyzing force to facilitate rapid increase in acreage and production of soybean since 36 years. It has also been instrumental in providing sustainability to soybean cultivation in different regions of the country.

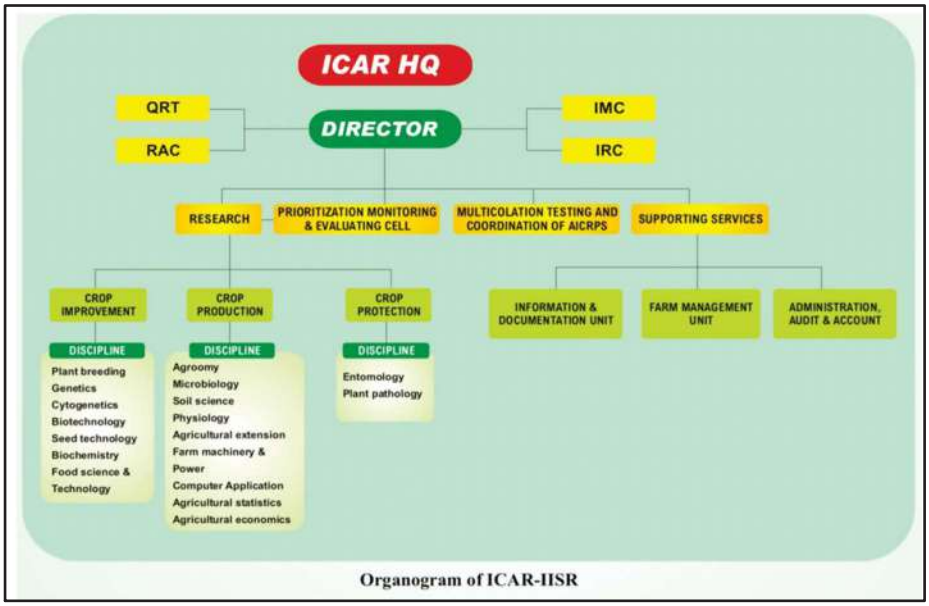
Mandate

To spearhead the research, give direction and support production systems' research, following mandates have been laid out:

- Basic, strategic and adaptive research on soybean for improving productivity and quality
- Provide access to information, knowledge and genetic material to develop improved technology and enhanced soybean production
- Coordination of applied research to develop location specific varieties and technologies
- Dissemination of technology and capacity building

Organizational set-up

For efficient functioning of institute and to achieve the mandate and objectives, the organizational pattern of the Institute has been evolved and depicted below:



Organogram of ICAR-IISR

Staff and budget

The total sanctioned staff position of ICAR-IISR as on 31st December 2023 is 101 comprising 34 scientific, 22 technical, 17 administrative and 27 supporting staff positions. Out of which 70 are in position as on 31st December 2023. The budget and expenditure during 2022-2023, and budget for 2023-24 is given below.

Budget and Expenditure of ICAR-IISR for 2022-2023 (Rs. in lakhs)

Head	R.E.	Actual expenditure
Grant in Aid-Pay & Allowances	1270.08	1270.08
Grant in Aid-Capital	72	72
Grant in Aid-General	325	324.74
Pension & Retirement Benefits	235.42	235.42
NEH	30	30
TSP	24	24
SCSP	60	60
Total	**2016.5**	**2016.24**
Revenue Generated	**65.38**	**-**

Budget of ICAR-IISR for 2023-2024 (Rs in lakhs)

Head	R.E.
Grant in Aid-Pay & Allowances	1300
Grant in Aid-Capital	150
Grant in Aid-General	580
Pension & Retirement Benefits	171
NEH	75
TSP	28
SCSP	87
Total	**2391**

3. Research Achievements

3.1 Genetic Resources: Conservation, Characterization and Utilization

NRCS1.1/87: Augmentation, management and documentation of soybean germplasm

PI: Sanjay Gupta, Co-PIs: Vangala Rajesh, Giriraj Kumawat, Gyanesh K. Satpute, Lokesh Kumar Meena, Savita Kohle and Ram Manohar Patel

Germplasm acquisition and maintenance

Quarantine of one hundred sixty eight *Glycine soja* accessions have been cleared by ICAR-NBPGR, New Delhi. Two hundred fifty accessions newly acquired from USDA were deposited in the long term storage (LTS) of NBPGR. Seven hundred forty-nine varieties imported from USDA are under quarantine at ICAR-IISR in the guidance of NBPGR. Four hundred seventy five quarantined cleared new accessions are under multiplication at IISR, Indore and UAS, Bengaluru. A total of 6221 germplasm accessions are being maintained in mid-term storage of ICAR-IISR Indore.

Germplasm evaluation

Under multi-location evaluation of a GWAS panel (322 accessions) at 7 locations in India, evaluation was conducted at Indore location for the second year. Mean, range and name of the top performing accessions are given in table 3.1.1.

Table 3.1.1: Mean, range and top performing accessions in 322 accessions evaluated at Indore

Traits	Mean	Range	Top performing accessions
Days to 50% flowering	47.8	35.00-60.00	EC 390977, BR 15, NRC 12, ICS 84/86-85 B-41, EC 528623 (Early Flowering)
Days to maturity	107.3	97.00-119.50	MACS 227, TGX 854-429, TGX 825-17 E, BR 15, MACS 124 (Early Maturity)
Plant Height (cm)	62.1	28.00-112.60	EC 291400, TGX 573-219 D, V 55, EC 287464, EC 389173 (More Height)
Number of nodes	12.3	6.70-22.45	EC 309529, EC 390981, EC 389173, TGX 573-219 D, TGX 854-60 A (More nodes)
Number of pods	29.6	8.90-77.00	EC 251388, TGX 854-77 D, AGS 193, TGX 860-11 D, JS 20-86 (More pods)
100 Seed weight (g)	6.8	3.17-13.03	B 160-3, BR 10, ACC 1026, JS 20-38, EC 390977 (Bold seed)
Grain yield/ plant (g)	2.8	0.17-9.73	RVS 2001-18, EC 390977, JS 20-38, EC 100778, ICS 84/86-85B-41 (higher yield)

Germplasm utilization

Development of genetic stocks and evaluation

For increasing the recipient (SL 958) genome, SL 958 (*E2e2E3e3* and *E3e3E4e4*) Near Isogenic Lines (NILs) were back crossed with SL 958. Twenty four NILs of SL 958 (*e1, e2, e3, e4*) were evaluated with 6 checks. Four genetic stocks *viz* NRC 225, NRC 229, NRC 230 and NRC 249 out yielded the best check (JS 20-34) by 15-49% (Table 3.1.2).

Table 3.1.2: Evaluation of NILs for grain yield and maturity

Genetic Stocks			Checks		
Genetic Stock	Yield (Kg/ha)	Maturity (Days)	Check Variety	Yield (Kg/ha)	Maturity (Days)
NRC 225	1863 (42%)	101	JS 20-34	1314	88
NRC 229	1632 (24%)	101	JS 20-98	818	104
NRC 230	1510 (15%)	102	NRC 138	1180	86
NRC 249	1965 (49%)	104	NRC 152	116	87
			RSC 10-52	336	102
			2011-35	299	102

Allele mining and PCR based marker development

Germplasm accession V 61 was identified with long juvenile allele *j* by Massarray method. The *j* allele in V61 was confirmed by sequencing and PCR based markers were developed for marker assisted selection in breeding programme. Two *Time of Flowering* genes *Tof 12* & *Tof 16* have been recently (2020-21) reported for conferring adaptation to higher and lower latitudes, respectively. Previously sequenced accession EC 241780 has been found to have InDels and SNPs in these genes.

Germplasm distribution

Three thousand nine hundred thirty seven germplasm accessions were distributed to 25 institutes and 7 centres of AICRP during 2022-23. Eight hundred forty nine germplasm accessions were supplied to scientists of the institute.

Development of varieties

Two long juvenile varieties NRC 157 and NRC 131 were notified for Madhya Pradesh state. One variety NRC 165 was identified for release in Central Zone. Four entries (LJ 128, LJ 131, LJ 135 and LJ 164) qualified in station trial for induction in IVT (Early) 2023 and one entry (LJ 50) to IVT (normal maturity). One entry (NRC 262) registered 23% yield advantage over the best check in IVT (early maturity) in AICRP trials and promoted to AVT I.

Development of Soybean Germplasm Status Information System

Preliminary prototype of Germplasm Status Information System is developed to maintain the status of soybean accessions available at ICAR-IISR, Indore. The user-friendly interface is developed using ASP.NET at front end. Modules for data management, information retrieval and report generation (excel sheet) are developed.Modules are developed to add new accessions, edit/delete existing accessions and to get information about the accession that need multiplication. Database is developed using SQL Server at back end to store the germplasm availability information. Different user-level authentications provided are-End-user, Germplasm In-charge and Admin. It is designed in such a way that it can be used for other crops also.

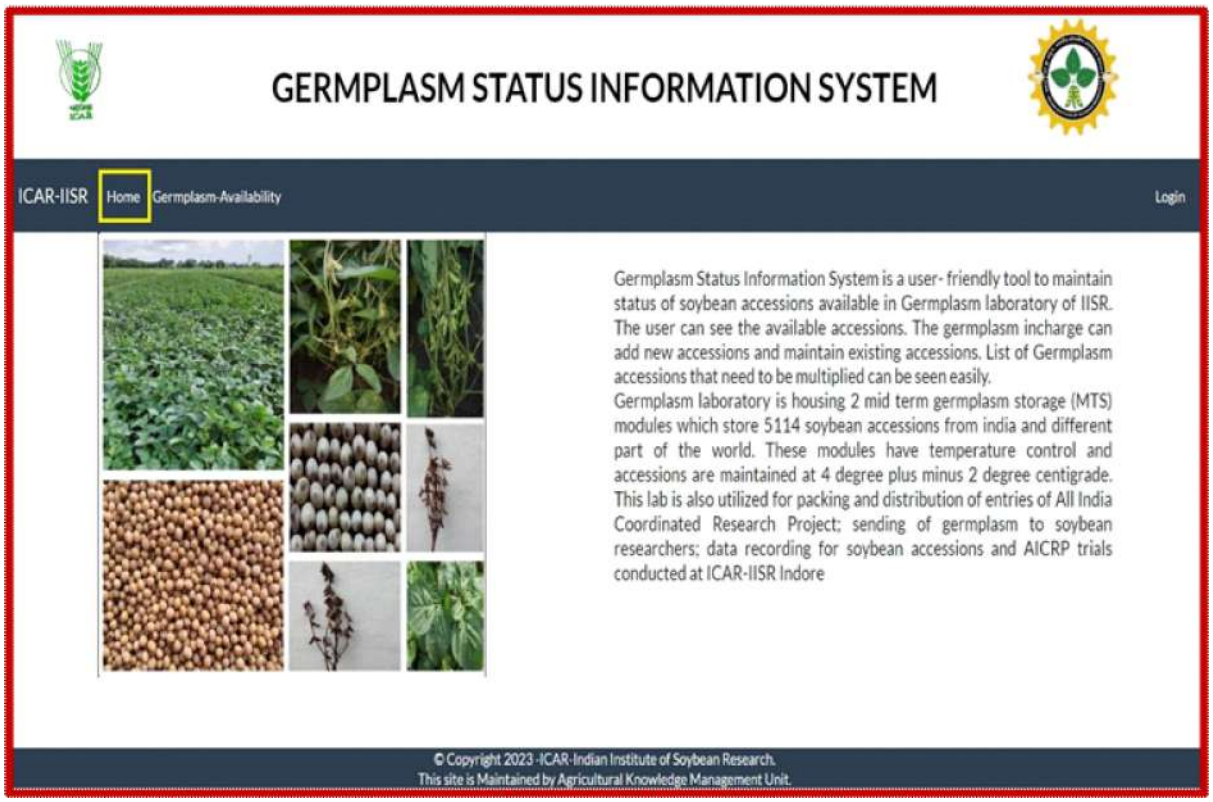


Figure 3.1.1 Home page of Germplasm Status Information System User Interface

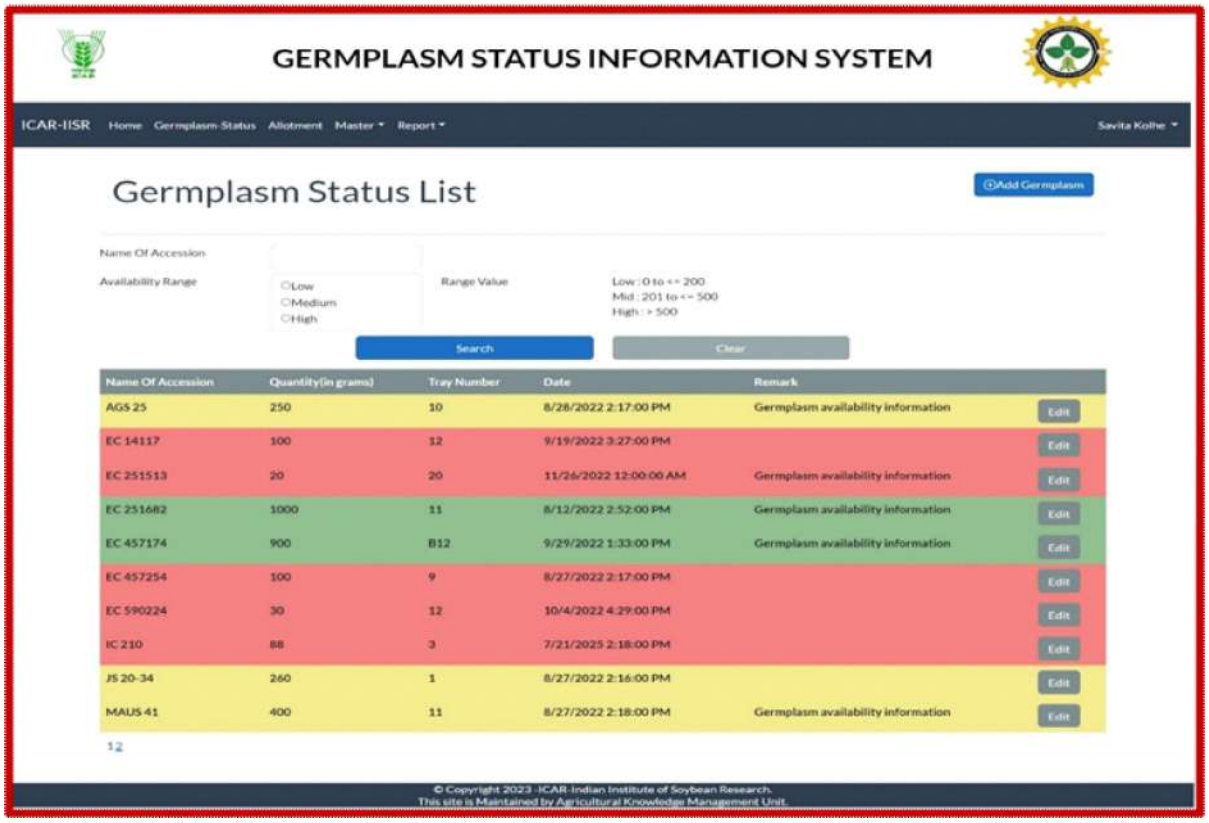


Figure 3.1.2 Web page showing availability status of soybean germplasm

IISR 4.6/23: Pre-breeding for broadening of genetic base in soybean

PI: Vangala Rajesh, Co-PIs: Sanjay Gupta, Shivakumar M, Vennampally Nataraj

Interspecific hybridization using primary genepool (*Glycine max* × *Glycine soja*)

Interspecific crosses were attempted utilizing *Glycine soja* with *Glycine max* (JS 95-60, NRC 138, JS 335, JS 97-52, KDS 753, MACS 1460, RSC 10-46, VLS 63, JS 9305, Dsb 34). F_2 generation for 9 interspecific crosses were advanced and grain yield per plant was recorded (Table 3.1.3).

Table 3.1.3 Grain yield per plant in F_2 generation for 9 interspecific crosses with mean and range

S.No	Cross	Generation	Mean	Range
1	JS 20-34 × PI 593893	F_2	1.34	0.1-4.3
2	JS 20-34 × PI 549046	F_2	3.14	0.3-6.8
3	JS 20-34 × PI 407170	F_2	1.45	0.1-12
4	JS 95-60 × PI 549046	F_2	1.42	0.1-3.4
5	JS 95-60 × PI 593893	F_2	1.07	0.1-4
6	JS 95-60 × PI 407170	F_2	0.77	0.1-3
7	JS 335 × PI 407170	F_2	1.37	0.1-5.36
8	JS 20-98 × PI 549046	F_2	1.8	0.1-7.2
9	EC 538828 × PI 549046	F_2	3.4	0.7-5.6

Figure 3.1.3: Depiction of variability in F_2 of interspecific cross of JS 20-34 × PI 407170 (*Glycine max* x *Glycine soja*)

Characterization of *Glycine soja*

Twenty five *Glycine soja* accessions Viz., EC 1165891, EC 1165824, EC 1165933, EC 1165787, EC 1165790, EC 1165850, EC 1165879, EC 1165842, EC 1165822, EC 1165791, EC 1165914, EC 1165863, EC 1165789, EC 1165820, EC 1165892, EC 1165826, EC 1165813, EC1165849, EC 1165808, EC 1165807, EC 1165839, EC 1165814, EC 1165897, EC 1165923 and EC 1165928 were characterized in field condition for qualitative and quantitative traits. Preliminary studies revealed genotypes exhibited high variability in speed of germination. The same 25 *Glycine soja* were distributed to 9 AICRP centres with different agroclimatic zones viz., Almora, Palampur, Dharwad, Imphal, Jabalpur, Kasbe Digraj, Ludhiana, Pantnagar and Raipur for characterization, multiplication and utilization.

3.2 Breeding for Early maturity, Higher Yield, Wider Adaptability and Food-grade Characteristics

IISR 4.4/23: Breeding for high grain and oil yield for different maturity duration in soybean

PI: Shivakumar M, Co-PIs:V. Nataraj, V. Rajesh. N. Raghavendra, Giriraj Kumawat

Hybridization for high grain yield and high oil

Crosses were attempted using parents for high yield and high oil and F_1s were harvested (Table3.2.1).

Table 3.2.1: List of crosses and targeted traits attempted during 2023 season

Name of Crosses	No. of F_1seeds	Target traits
NRC 142 x F6 (NRC 128 x JS 95-60)	73	High yield and high oil content
NRC 150 x GW 53	44	High yield
JS 95-60 x GW 10	36	High yield
JS 95-60 x NRC 148	28	High oil content
POP2 x NRC 142	29	High yield and high oil
F6 (NRC 128 x JS 95-60) x NRC 150	28	Early maturity and high yield
NRC 150 x GW 10	20	High yield
GW 30 x JS 95-60	19	High yield
NRC 150 x YP 48	16	Early maturity and high yield
JS 95-60 x EC 528226	14	High oil content
GW18 X NRC 150	13	Early maturity and high yield
SKAUS-1 x NRC 150	12	High seed weight
JS 95-60 x TGX 854-429	12	Early maturity and high oil content
NEC 150 x JS 95-60	11	High oil content
NRC 150 x YP 43	11	High oil content
EC 95815 x JS 95-60	10	High oil content
GW 53 x NRC 142	10	High yield and high oil content
JS 335 x Oy 49-4	9	High yield
POP2 x EC 95815	9	High yield and high oil content
YP 43 x NRC 150	9	High yield
GW 18 x YP 48	8	High oil content
NRC 142 x EC 95815	6	High oil content
GW 53 x JS 95-60	6	High yield
F6 (NRC 128 x JS 95-60) x PoP2	6	High yield
GW 18 x NRC 142	2	High yield and high oil content
GW 53 X NRC 142	5	High yield and high oil content
NRC 252 x JS 20-34	3	Early maturity and high yield
JS 95-60 x GW 53	5	High yield
F6 (NRC 128 x JS 95-60) x NRC 181	5	High yield
JS 95-60 x EC 95815	3	High oil content
e3e4 x e2 100 sw- JS 97-52-BC3F1	29	Early maturity and bold seededness
e3e4 x e2 100 sw-NRC 127-BC3F1	14	Early maturity and bold seededness
JS 97-52 x e2100 sw- -BC2F1	96	Early maturity and bold seededness
NRC 127 x e2100 sw- -BC2F1	22	Early maturity and bold seededness

Evaluation of promising progenies (advanced breeding lines F_6) for grain yield in replicated trial

A total of 34 advanced breeding lines including two checks; JS 20-34 and NRC 142 were evaluated for yield and attributing traits (Table 3.2.2). Grain yield was recorded highest (3081 Kg/ha) in the entry 18 derived from the cross NRC 128 x JS 95-60 followed by entry 30 (2848 Kg/ha) from same cross. Early maturing entries viz., A-184, A-31, A-162 produced yield >21 q/ha with maturity duration of 90 days.

Table 3.2.2: Details of the promising entries for yield and 100 seed weight

Genotype	Grain yield (Kg/ha)	100 SW (g)	Days to maturity	% Superiority over check
14-1	1521	11.8	91	-4.03
15-1	1274	13.6	88	6.1
16-1	1688	14.3	90	48.5
38	1970	15	88	19.54
18	3081	14.1	99	48.55
15	817	10.6	108	-94
14	2385	15.8	108	33.54
39	1837	12.6	108	13.71
13	2685	15.6	98	40.96
30	2848	13	106	44.34
25	2161	10.8	109	26.65
10	2014	14.3	109	21.3
2	1881	13.9	111	15.73
19	2491	15.6	111	36.37
41	1777	10.2	102	10.8
49	1419	11	102	-11.69
28	1524	10.1	108	-4
23	1629	9.4	105	2.7
34	1555	11.2	101	-1.92
1	1955	12.7	108	18.92
16	2192	10.9	108	27.65
26	2355	13.2	101	32.69
37	1733	14.8	114	8.54
5	1674	12.9	114	5.31
31	2251	14.1	108	29.58
42	2237	14.4	102	29.14
27	1700	13.3	114	6.76
29	1125	10.4	111	-40.8
A-31(40)	2118	14.8	90	25.16
A-162(35)	2103	15.5	92	24.63
A-184 (36)	2223	13.3	79	28.69
1-1	1970	14.2	89	19.54
JS 20-34	623	10.3	96	-154.41
NRC 142	1585	12.9	98	-
CV	24.58	14.1		
SE	85.82	0.33		

Selections in segregating generations for high pods per plant and100 seed weight

A total of 350 F_2 plants from 1 0 different crosses were selected based on number of pods per plant. Similarly, 200 plants from F_3 generation and 60 F_4 bulks were selected based on number of pods per plant and grain yield per row (2 meters) respectively.

Genetic stock registered

NRCSL 8, a genotype developed using *Glycine soja* as donor in the background of JS 335, was found resistant reaction against multiple key disease like yellow mosaic disease (YMD) (at Ludhiana, figure 3.2.1), charcoal rot, anthracnose, rhizactonia aerial blight (RAB) and Asian soybean rust at multiple locations including hotspots Jabalpur (Charcoal rot, RAB and YMD). NRCSL 8 was registered with ICAR-NBPGR, New Delhi. NRCSL 8 revealed moderately resistant reaction to Asian soybean rust at hotspots both Ugarkhurd and UAS Dharwad and it may be useful genetic resource for development of moderately resistant soybean varieties in India.

Figure 3.2.1: A. JS 335 and B. NRCSL8, under natural epiphytotic conditions of yellow mosaic disease at Ludhiana

DBT Project: Marker assisted introgression of seed weight, early maturity and photoperiod response genes in a multiple stress tolerant climate smart soybean variety JS 97-52 and KTI free variety NRC 127

PI:Shivakumar M, Co-PIs: Giriraj Kumawat, Sanjay Gupta and *V. Nataraj*

Foreground selection was carried out using markers linked to photo-insensitivity (*e3&e4*) early maturity (*e2*) and 100 seed weight in 61 BC_3F_1 generation derived from JS 97-52 x (14-36A × 8-94-4). The results revealed six plants were found to carry *e3, e4, e2* and 100 seed weight alleles. Fore ground selection will be again carried out in BC_3F_2 plants for selection of homozygous plants for *e3, e4, e2* and 100 seed weight alleles.

NRCS1.12/02 : Breeding for food grade characters and high oil content

PI: Anita Rani, CoPI: Vineet Kumar

Table 3.2.4: Improved varieties and genotypes developed for food grade characters

Genotype	Trait
NRC 181	An early maturing genotype free from KTI has been released for cultivation in Central Zone by CVRC
NRC 188	First vegetable soybean variety of central India, has been released for cultivation in Central Zone by CVRC
NRC 197	An early maturing KTI free genotype has been promoted to AVT II in North Hill Zone
NRC 258	A high oil genotype has been promoted to AVT I in Central Zone.
NRC 268	A lipoxygenase 2 free genotype has entered in IVT 2023
NRC 285	Black soybean genotype free from KTi has been developed for culinary purpose

Figure 3.2.2: NRC 181 and NRC 188–Food grade character varieties released for cultivation in Central Zone

NASF Project: Marker assisted stacking of yellow mosaic disease resistance, null Kunitz trypsin inhibitor, null lipoxygenase-2 genes, and broadening the genetic base of soybean

PI: Vineet Kumar; Co-PIs: Anita Rani, Sanjay Gupta and Vangala Rajesh

Parental polymorphism survey across 20 linkage groups for parental combinations NRC14 2× SL955, PS1347 × NRC142, AVSB2012 × NRC142 and AVSB2013 × NRC142 has been completed. Total number of SSR markers surveyed across 20 linkage groups for parental combinations NRC142×SL955, PS1347 × NRC142, AVSB2012×NRC142 and AVSB2013 ×NRC142 were 375, 380, 376 and 381, respectively, selecting at least one SSR marker within 5 cM distance. Number of SSR markers found to be polymorphic for NRC142 ×SL955, PS1347 × NRC142, AVSB2012 ×NRC142 and AVSB2013 × NRC142 were 152, 155, 165 and 211, respectively. Thus, polymorphism observed was 40.53% for NRC142×SL955, 40.78% for PS1347× NRC142, 43.88% for AVSB2012 × NRC142, and 55.38% for AVSB2013×NRC142 (Table 3.2.5).

Putative F_1 seeds for the cross NRC142×SL955 were sown in January 2023 and confirmed for hybridity using YMD linked SSR markers (GMAC7L and Satt322). From this hybridity validity test, 5 true F_1 plants were confirmed and $F_{1:2}$ seeds were harvested. F_2 seeds were sown in cropping season 2023 and F_2 plants with YMD resistant gene were confirmed using YMD linked SSR

marker and backcrossed with recipient parent NRC142 (*titilx2lx2*) to obtain putative BC_1F_1 seeds. In cropping season 2023, crosses were effected between parental combinations AVSB2012×NRC142 and AVSB2013×NRC142 to obtain putative F_1 seeds.

Based on the multilocation evaluation (Palampur, Almora, Indore, Pantnagar, Parbhani, Imphal, Pune) of 322 germplasm accessions and zonal check varieties, diverse parents were identified for hybridization programme under AICRP on soybean. For different agroclimatic zones, hybridizations between the adapted variety of the zone and the diverse germplasm identified based on the D^2 analysis were conducted in *Kharif* 2023. F_1 seeds of 101 parental combinations developed in *Kharif* 2022 were advanced to F_2 in off season (*Rabi* 2023) at ICAR-IISR, Indore. F_2 plants are being advanced to F_3 at Indore and Bengaluru centers. For development of lines with photoperiodic allelic combinations in the background of SL958, hybridizations were conducted among 12 parental combinations which include NILs of different photoperiodic alleles.

Table 3.2.5: Parental polymorphism surveyed across 20 linkage groups

Parental Combinations	NRC142 × SL955		PS1347 × NRC142		AVSB2012 × NRC142		AVSB2013 × NRC142	
LGp\Chr	M	P	M	P	M	P	M	P
A1 (Chr 5)	11	5	12	4	8	7	6	10
A2 (Chr 8)	20	10	15	15	15	15	17	13
B1 (Chr 11)	10	8	10	8	7	11	5	13
B2 (Chr 14)	13	4	9	8	5	12	5	12
C1 (Chr 4)	14	1	12	3	11	4	11	5
C2 (Chr 6)	17	19	21	15	18	19	17	20
D1a (Chr 1)	8	7	11	4	8	7	8	6
D1b (Chr 2)	12	15	18	9	16	10	10	17
D2 (Chr 17)	16	6	20	3	14	7	11	12
E (Chr 15)	4	5	6	5	3	7	4	7
F (Chr 13)	10	17	10	17	13	14	12	15
G (Chr 18)	9	4	6	7	7	6	4	8
H (Chr 12)	12	1	8	5	11	2	5	8
I (Chr 20)	9	6	7	8	9	6	6	9
J (Chr 16)	10	7	10	7	12	5	9	8
K (Chr 9)	8	7	9	7	10	6	7	9
L (Chr 19)	9	9	13	5	9	9	9	9
M (Chr 7)	14	3	11	6	15	2	9	8
N (Chr 3)	7	7	8	7	8	7	6	9
O (Chr 20)	10	11	9	12	12	9	9	13
Total	223	152	225	155	211	165	170	211
% Polymorphism	**40.53**		**40.78**		**43.88**		**55.38**	

Figure 3.2.3: Confirmation of true F_1 plants using 'BARCSOYSSR_06_0662' SSR marker in NRC142×SL955 cross. Lane L corresponds to 50 bp DNA ladder. P1 and P2 corresponds to NRC142 and SL955, respectively; and lanes showing amplicon form both the parents P1 and P2 corresponds to true F_1 plants.

3.3 Breeding for Abiotic Stress Tolerance

DSR 5.6a/08:Breeding for drought tolerant varieties in soybean

PI: Gyanesh Kumar Satpute, CoPIs: Sanjay Gupta, Milind Ratnaparkhe, Giriraj Kumawat, Prince Choyal,Rakesh Kumar Verma, Vangala Rajesh and Sanjeev Kumar

Hybridization

A total of twenty-nine F_1s were achieved by attempting crosses between six well-adapted varieties as female parents *viz.* JS 20-34 (CZ-Early), AMZ 100-39 (CZ), RSC 10-46 (EZ), DSb 34 (SZ), NRC 136 (CZ & Madhya Pradesh State) and drought-tolerant donors *viz.* TGX 709-50E, J 732, EC 107-104, PI 159923, NRC 137, NRC 256, NC 189, NRC 190, NRC 257.

Table 3.3.1: List of fresh crosses attempted and F_1s harvested

S.No.	Cross	No. of Seeds
1	JS 20-34 x PI 159923	22
2	JS 20-34 x NRC 137	23
3	AMS 100-39 x TGX 709-50E	4
4	AMS 100-39 x EC 107407	7
5	AMS 100-39 x NRC 137	19
6	AMS 100-39 x NRC 256	9
7	AMS 100-39 x NRC 257	24
8	RSC 10-46 x J 732	2
9	RSC 10-46 x PI 159923	2
10	RSC 10-46 x NRC 256	10
11	RSC 10-46 x NRC 189	2
12	RSC 10-46 x NRC 190	9
13	RSC 10-46 x NRC 257	7
14	DSb 34 x TGX 709-50E	2
15	DSb 34 x J 732	8
16	DSb 34 x EC 107407	15
17	DSb 34 x PI 159923	20
18	DSb 34 x NRC 137	33
19	DSb 34 x NRC 256	9
20	DSb 34 x NRC 257	16
21	KDS 753 x TGX 709-50E	6
22	KDS 753 x J 732	12
23	KDS 753 x EC 107407	4
24	KDS 753 x NRC 137	20
25	KDS 753 x NRC 256	12
26	KDS 753 x NRC 189	7
27	KDS 753 x NRC 190	15
28	KDS 753 x NRC 257	15
29	NRC 136 x NRC 257	4
Total		**338**

Table 3.3.2: Advancement of multi-parent F_1 populations

S.No.	F_2 cross populations
1	[(JS71-05xNRC 37) X (TGX 328-049) / (AMS MB 5-18xJS 95-60) X (PI 159923 x JS 95-60)]
2	[(AMS MB 5-18xJS 95-60) X (PI 159923xJS 95-60) / (AMS MB 5-18 x JS 95-60) X (PI 159923 x JS71-05)]
3	[(AMS MB 5-18 x JS 95-60) X (PI 159923 x JS 95-60) / (PI 159923 x NRC 37) X (PI 159923 x JS 95-60)]
4	[(38-11-265 x JS 95-60) X (JS71-05 x NRC 37) / (AMS MB 5-18 x JS 95-60) X (PI 159923 x JS 95-60)]
5	[(PI 159923 x NRC 37) X (PI 159923 x JS 95-60) / (38-11-265 x JS 95-60) X (JS71-05 x NRC 37)]
6	[(JS71-05 x NRC 37) x (TGX 328-049) / (PI 159923 x NRC 37) X (PI 159923 x S 95-60)]
7	[(AMS MB 5-18 x JS 95-60) X (PI 159923 x JS71-05)/ (38-11-265 x JS 95-60) X (JS71-05 x NRC 37)]

F_2-F_3 selections for Off-season rapid generation advancement

Twenty-five individual plant selections (seed yield $\geq$ 20g. plant^{-1}) from four F_2 populations were sent for off-season rapid generation advancement at AICRPS Bengaluru.

Table 3.3.3: F_2 selections sent for off-season rapid generation advancement at AICRPS Bengaluru

S.No.	F_2 Cross Population	No. of Selections
1	(AMS MB 5-18xJS 95-60) X (PI 159923xJS 95-60)	1
2	(JS71-05xNRC 37) X (AMS MB 5-18xJS 95-60)	3
3	(JS71-05xNRC 37) X EC 602288	12
4	JS71-05xNRC 37	9
Total		**25**

Selections in F_2 and F_3 populations

In thirteen F_2 and thirteen F_3 populations 59 and 44 individual plant selections (IPSs), respectively, were practiced (Table 3.3.4). In two advanced generation populations a total of 17 IPSs were made.

Table 3.3.4: Selections in F_2 and F_3 populations

Cross	IPSs
F_2 populations	
(AMS MB 5-18 x JS 95-60) X (PI 159923 x JS71-05)	5
GKS 20-7 X NRC 137	4
(AMS MB 5-18 X JS 95-60) X (PI 159923 X JS 95-60)	3
(JS 71-05 X NRC 37) X (AMS MB 5 18 X JS 95-60)	13
(JS 71-05 X NRC 37) X EC 602288	22
(AMS MB 5-18 x JS 95-60) X (PI 159923 x JS71-05) / (38-11-265 x JS 95-60) X (JS71-05 x NRC 37)	6
[(JS71-05 x NRC 37) X Drt2 (TGX 328-049)] / [(AMS MB 5-18 x JS 95-60) X (PI 159923 x JS 95-60)]	5
JS 71-05 X NRC 37 X PI 159923 X NRC 37	1
Total	**59**
F_3 populations	
JS 71-05 X NRC 37	25
NRC 136 X GKS 21-3	1
GKS 20-7 x NRC 137	1
NRC 137 X GKS 21-4	1
AMS MB 5 18 X JS 95-60	1
JS 71-05 X NRC 37	15
Total	**44**
Advanced Generation Populations	
G4 BULK F5 [(C-2797 x JS 71-05) x (PK 472 x JS 335)] / (JS 335 x Young) x (EC 602288 x JS 90-41)]	7
116 F_7	10
Total	**17**

Phenotyping of an advanced RILs population

Four tolerant viz. JS 97-52, JS 20-69, EC 602288, NRC 136, and four sensitive checks viz. JS 335, NRC 37, JS 90-41, and NRC 2 along with advanced RILs population (F_7: 279 lines) derived from a cross EC 602288/ NRC 2 were phenotyped for drought tolerance traits. In an off-season field trial under reduced soil moisture conditions, the population was characterized at the seed fill stage for delayed leaf senescence (score 1-5), canopy temperature depression (°C), and canopy greenness (SPAD chlorophyll meter readings).

Table 3.3.5: Exploratory analysis of drought tolerant traits in RILs population

Check Var.	DLS	CTD (C°)	SCMR
JS 97-52 (T)	4	1.1	44
JS 20-69 (T)	4	1	42
EC602288 (T)	4	0.9	29
NRC-136 (T)	3	0.9	42
JS-335 (S)	2	0.5	29
NRC-37 (S)	2	0.5	29
JS 90 41 (S)	1	0.7	16
NRC 2 (S)	1	0.4	14
Mean	3	0.8	35
Range	1 - 5	0.4-2.0	14-44.2
SD	0.6	0.2	4.3

Tolerant checks had higher delayed leaf senescence (DLS), canopy temperature epression (CTD), and canopy greenness (SCMR) values as compared to sensitive checks. Sufficient variation was present in the RILs population for these traits. Transgressive segregation was expressed in lines 115-150, 115-159 for delayed leaf senescence, in 73 lines including 115-150 for canopy temperature depression, and 262 lines including 115-150, 115-159 for canopy greenness (Table3.3.5).

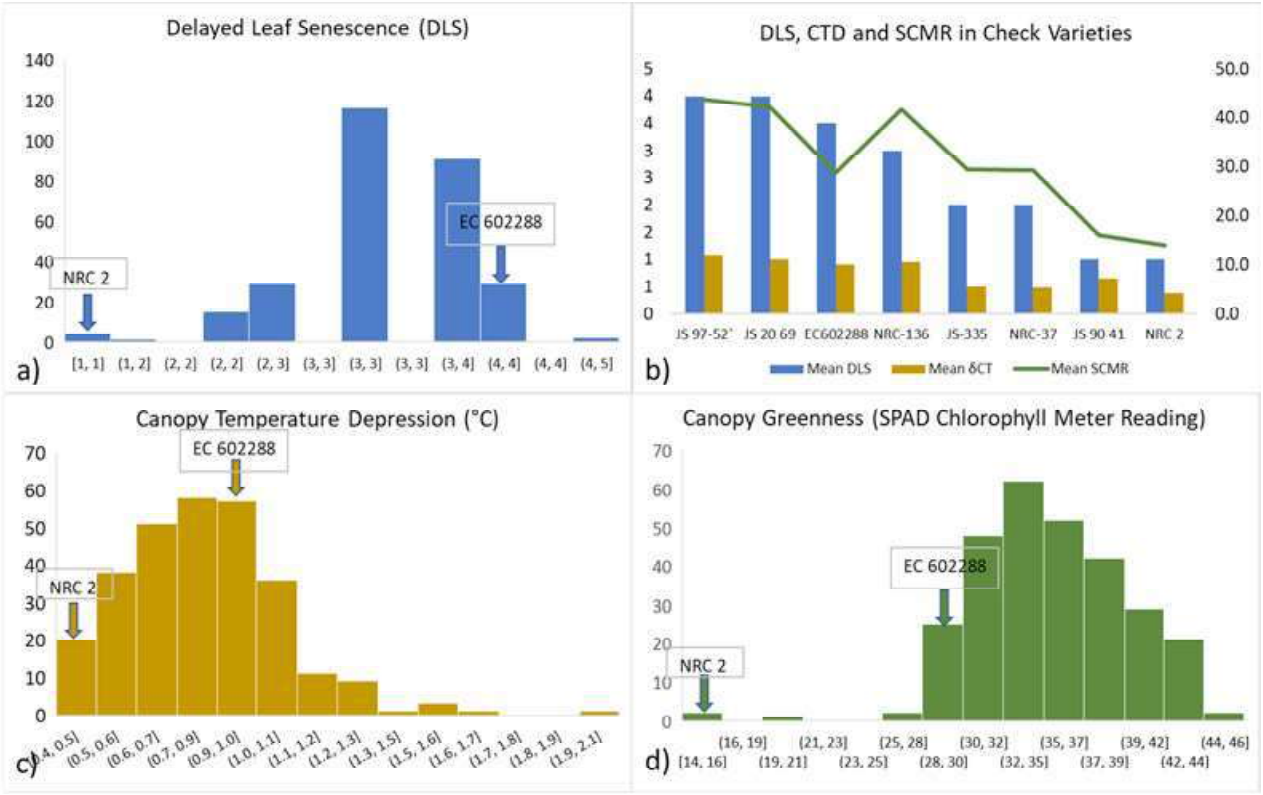


Figure 3.3.1:Histograms for drought tolerant traits in RILs population (EC 602288 x NRC 2)

Preliminary evaluation of advanced breeding population for yield and desiccation tolerance

Advanced breeding population (F_7: 124 lines) derived from twenty-eight 4-ways crosses involving drought-tolerant parents were evaluated preliminarily for yield as well as desiccation tolerance by spraying the whole canopy at seed fill stage with Potassium iodide (0.2% w/v). Seventeen lines were found high yielder (>2000 kg/ha). Among them, three lines viz. M-51-2-6, M-22-26 and M-54-4A-8 showed high desiccation tolerance in terms of 55.2, 45.1 and 38.8 per cent stem reserve mobilization, respectively. Line M-51-2-6 simultaneously also showed less biomass decrease (14.3%) (Table 3.3.6). Desiccation sensitive check NRC 37 had very low stem reserve mobilization (15%) with high biomass decrease of 48.5% as compared to tolerant check JS 97-52 (46.2%) with low biomass decrease (16.5%).

Table 3.3.6: High-yielding lines and descriptive statistics for check varieties

S. No.	Line	Yield (kg/ ha)	100 Seed Wt (g)	SRM (%)	Biomass decrease (%)	Reaction to diseases			
						MYMV	Anthracnose	RAB	BP
1	M-54-3B-2	2728	8.8	30.4	52.9		MR		
2	M-51-1A-1	2715	11.9	4	78.2		R		
3	M-52-2-2	2508	8.4	30.3	44.8		R	MR	
4	M-23-2	2476	11.2	26.6	49.7	MR	R		
5	M-51-2-6	2411	9.8	55.2	14.3		MR	MR	
6	M-10-2A-18	2235	9.5	-	-		HR		
7	M-41-7	2230	13	33.6	53.1				
8	M-22-26	2210	11.4	45.1	42				
9	M-54-4A-8	2189	11.2	38.8	28.5		MR		
10	M-22-10	2155	12.3	15.9	73.5		MR		
11	M-31-6	2142	8.5	20.5	68.9		MR		
12	M-39-4	2087	10.9	23.7	47.8				
13	M-51-3-2	2085	8.9	11.6	65.7				
14	M-27-6	2079	11.8	-	46.7		R		
15	M-22-2	2050	9.5	28.6	51.6	MR	MR		
16	M-52-2-12	2050	8.6	34.6	46		R		MR
17	M-27-1	2029	9.7	42.9	44.7	MR	HR		MR
18	JS20-69	664	6.4	47.7	26.7				
19	JS97-52 (T)	949	7.2	46.2	16.5				
20	DSb34	1796	9.7	71.1	22.7				
21	RVS76	633.9	7.4	39.7	23.8				
22	NRC37 (S)	1236	10.4	15	48.3				
	Mean	1056	8.2	43.9	27.6				
	Stand. Dev.	481	1.7	20.1	12.2				
	Stand. Error	215	0.8	9	5.4				

Table 3.3.7: Pearson's correlation matrix for drought tolerance and yield-related traits

	Biomass Decrease%	100-SdWt	Seed Yield
SRM%	-0.792**	-0.126NS	-0.062NS
Biomass Decrease%		0.194NS	0.255*
100-SdWt			0.420**

*=significant at 5 %, ** = significant at 1 % and NS = non-significant

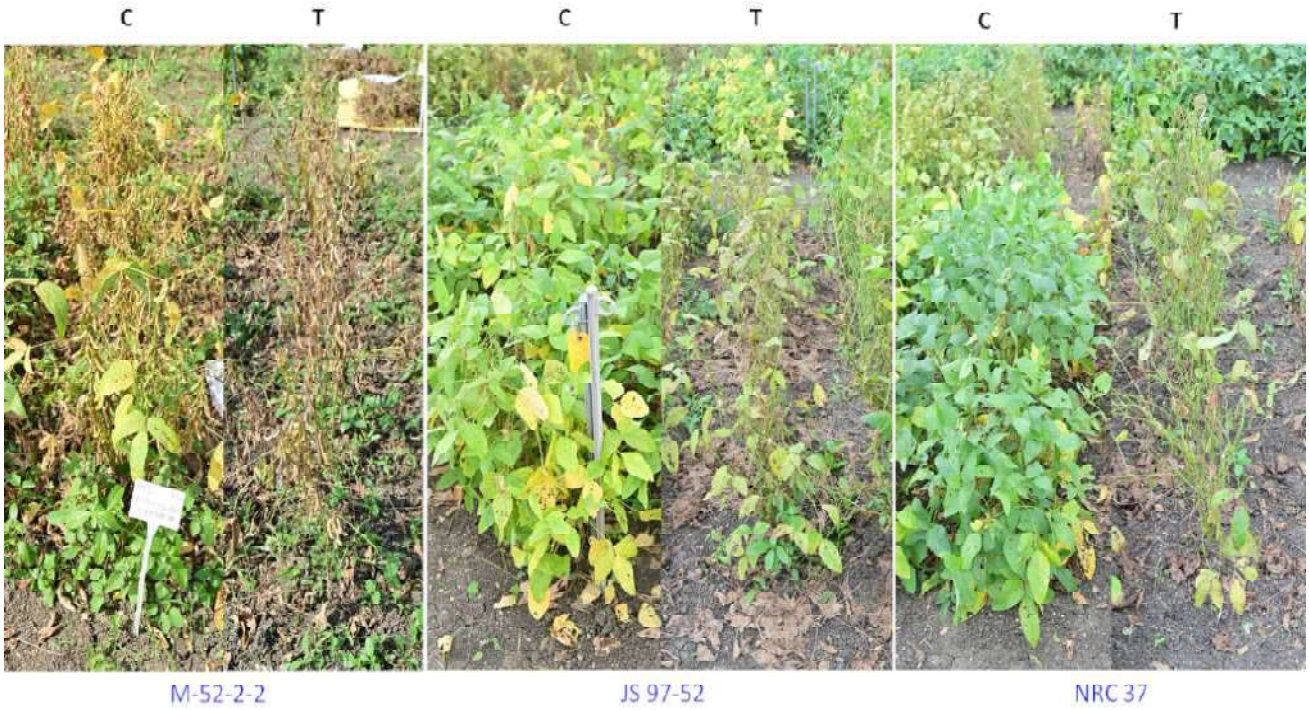


Figure 3.3.2: Field performance of desiccation-tolerant line M-52-2-2 as compared to tolerant JS 97-52 and sensitive NRC 37 checks

This population was also screened for MYMV disease at hotspot, AICRPS Ludhiana, along with drought tolerant EC 602288 and sensitive NRC 2 checks. EC 602288 showed moderately resistant and NRC 2 highly susceptible reactions to MYMV. Five breeding lines *viz.* M-3-8, M-22-29, M-53-4-24, M-23-14, and M-42-3 expressed resistance, and 14 lines moderately resistant reactions.

Screening of the same breeding population (F_7: 124 lines) under natural field conditions at ICAR-IISR, Indore revealed a highly resistant reaction to Anthracnose in 15 lines *viz.* M-3-8, M-5-3, M-5-14, M-10-2B-3, M-10-2A-18, M-19-3, M-24-1, M-24-6, M-27-1, M-27-4, M-31-1, M-51-1B-14, M-53-4-6, M-53-4-9 including check JS 97-52 and resistant reaction in 30 lines. Five lines *viz.*, M-8-14, M-10-2B-3, M-19-3, M-49-2-3, and M-50-1-1 expressed resistant reaction to Rhizoctonia Arial Blight (RAB) disease.

Out of 11 advanced breeding lines (F_7), derived from the same population and tested for insect resistance, nine breeding lines viz. M-3-1, M-3-8, M-7A-11, M-7B-4, M-37-1, M-37-2, M-37-6, M-37-16, and M-37-18 were found moderately resistant to girdle beetle and six lines M-3-1, M-7A-11, M-7B-4, M-8-9, M-37-6 and M-37-18 to defoliators (Table 3.3.8). None of the lines showed resistance to stem fly. Line M-48-1 expressed a highly resistant reaction to bacterial pustule (BP) and frog eye leaf spot (FLS).

Table 3.3.8: Reaction of advance breeding lines to stem fly, girdle beetle and defoliators

Code No.	Entry	Stem fly (% stem tunneling)	Girdle beetle (% Infestation)	Defoliators (% Damage)
1	M-3-1	44.16	1	5.84
		(41.64)HS	(5.74)MR	(13.98)MR
2	M-3-8	44.83	1	7.5
		(42.03)HS	(5.74)MR	(15.89)LR
3	M-7A-11	63.09	1	5.83
		(52.59)HS	(5.74)MR	(13.97)MR
4	M-7B-4	52.29	1	2.5
		(46.31)HS	(5.74)MR	(9.10)MR
5	M-8-9	32.49	17.67	5.84
		(34.75)LR	(24.86)HS	(13.98)MR
6	M-8-14	37.17	13.5	12.5
		(37.57)S	(21.56)S	(20.70)LR
7	M-37-1	61.06	1	14.17
		(51.39)HS	(5.74)MR	(22.11)LR
8	M-37-2	36.19	1	8.34
		(36.98)S	(5.74)MR	(16.78)LR
9	M-37-6	78.01	1	5
		(62.03)HS	(5.74)MR	(12.92)MR
10	M-37-16	36.97	1	8.34
		(37.44)S	(5.74)MR	(16.78)LR
11	M-37-18	55.94	1	5.83
		(48.41)HS	(5.74)MR	(13.97)MR
Sem ±		-4.66	-5.39	-3.7
CD at 5%		-10.37	-12.01	-8.25

Multilocation evaluation of soybean varieties under low rainfall situations

Sixteen newly released varieties were evaluated at Indore, Kota, and Baramati in Randomized block design. At Indore, the set was also evaluated in rainout shelter-activated conditions and for root traits. The data has been received from all the Centres along with meteorological data and is under evaluation.

Entry evaluated in AICRPS multi-location yield trial in IVT NEH Zone

NRC 190, a high yielding drought tolerant entry derived from a cross JS 97-52 x JS 355, is repeated third year in a row in IVT-2023 trial along with other entries for evaluation in North Eastern Hill Zone.

Figure 3.3.3: NRC 190, a high yielding drought tolerant entry in IVT 2023 NEHZ

Entries in State Multi-Location Trial evaluation

Two drought tolerant entries NRC 136 and NRC 137 derived from a cross (JS 97-52/ NRC 37) were in3rd year of testing during kharif 2023 in Maharashtra (NRC 136 & NRC 137) and Chhatisgarh (NRC 137) States.

IISR7.8/23:Trait identification and physiological breeding for waterlogging tolerance in soybean

PI: Prince Choyal, Co-PIs: Gyanesh Kumar Satpute, Giriraj Kumawat and Nataraj V.

Evaluation of soybean germplasm for pre-emergence anaerobic stress (waterlogging stress) tolerance

A set of 200 soybean germplasms were evaluated for waterlogging tolerance at pre-emergence stage in waterlogging structures during *Kharif* 2023. A period of 72 hours of waterlogging stress was imposed through maintaining the 10 cm of water layer on pots above the soil surface just after sowing. After completion of the treatment period, the pots were allowed to recover for one week and the germination percentage were recorded. Out of 200, thirty germplasm were showed tolerance to waterlogging stress at pre-emergence stage. The range of germination percentage under waterlogging stress was 3.3 % to 86.7 %. EC 81822 (50%), EC 0076754 (56.7%) and EC 251413 (86.7%) were the best performing germplasm under 72 hours of waterlogging stress.

Figure 3.3.4 : Soybean germplasm under water logging stress at pre emergence stage

Evaluation of soybean genotypes for waterlogging tolerance at reproductive stage

A set of 62 soybean genotypes consists of 25 advance breeding lines, RILs and soybean germplasm including four checks were evaluated for waterlogging tolerance at reproductive stage in randomized block design with three replications in flooded field (Figure 3.3.5). Water was stagnated at full flowering stage for 15 days in flooded field and normal moisture level was maintained in control field.

Figure 3.3.5 : Soybean genotypes under water logging stress at reproductive stage

ISSR 3.16/21 Identification of genes/loci for better root system in soybean

PI: Giriraj Kumawat, Co-PIs: Milind B. Ratnaparkhe, Gyanesh K. Satpute, Shivakumar M. and Prince Choyal

Phenotyping of germplasm for root traits at 3 weeks growth stage

A germplasm set of 234 accessions was phenotyped for various root traits using hydroponic culture. Primary root length (PRL), total root length (TRL), root diameter (RDM), surface area (SA), root volume (RV) and root tips (RT), were recorded after three-weeks growth of plant (Table3.3.9, Figure 3.3.6). TRL and RV was highest in accession EC251405, whereas EC358009 showed lowest value for these traits.

Table 3.3.9: Descriptive statistics of various root traits in 234 germplasm accessions

	PRL (cm)	TRL (cm)	SA (cm2)	RDM (mm)	RV (cm3)	RT
Minimum	36.75	737.04	138.33	0.5	1.94	719
Maximum	79.05	2180.37	694.74	1.3	10.72	2626
Mean	56.94	1420.25	324.87	0.8	5.83	1593
Standard Deviation	7.89	279.78	80.88	0.16	1.82	396.6
CV(%)	13.85	19.7	24.9	20.31	31.27	24.88

Figure 3.3.6: Phenotypic variation in root architecture traits in germplasm accessions at three-weeks stage

Genome wide association study for root traits at three weeks growth stage

Genome wide association analysis of SNP markers with root traits phenotyping data in 234 genotypes identified significant loci associated with primary root length, total root length, root volume, surface area and root tips (Figure 3.3.7).

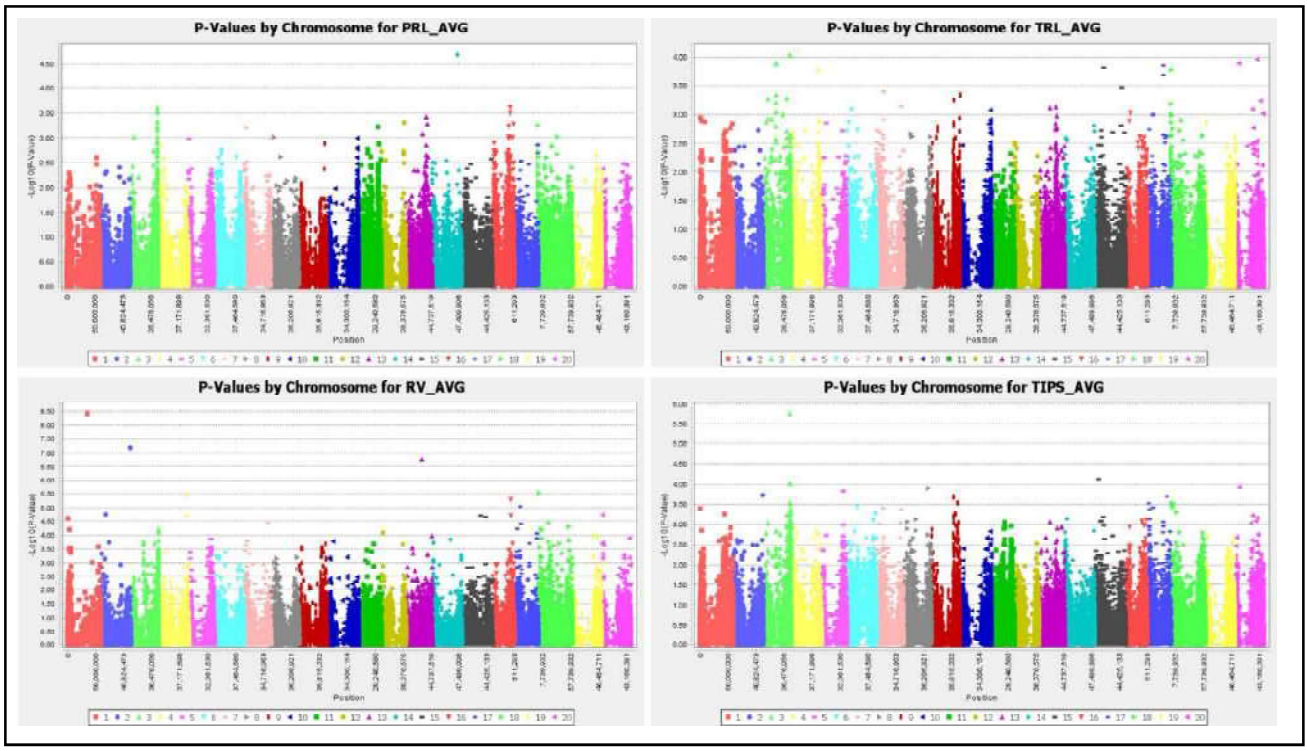


Figure 3.3.7: Manhattan plots of SNP loci associated with primary root length (PRL), total root length (TRL), root volume (RV) and root tips among 234 soybean germplasm

Gene expression profiling for *SOR1-like* genes in contrasting lines

Seventeen *SOR1-like* genes were characterized for phylogenetic relationship, conserved motifs, protein characteristics and gene structures. Seven genes were used for differential gene expression profiling in accessions contrasting for total root length. The four high rooting GW40, GW208, GW258, and GW271, and four low rooting genotypes GW141, GW180, GW108 and GW218, were selected. Gene expression analysis of seven *SOR1-likes* genes revealed differential expression of two genes. *Glyma.01g097900* showed differential expression for primary root length and *Glyma.06g091651* showed differential expression for lateral root length in eight contrasting genotypes (Figure3.3.8).

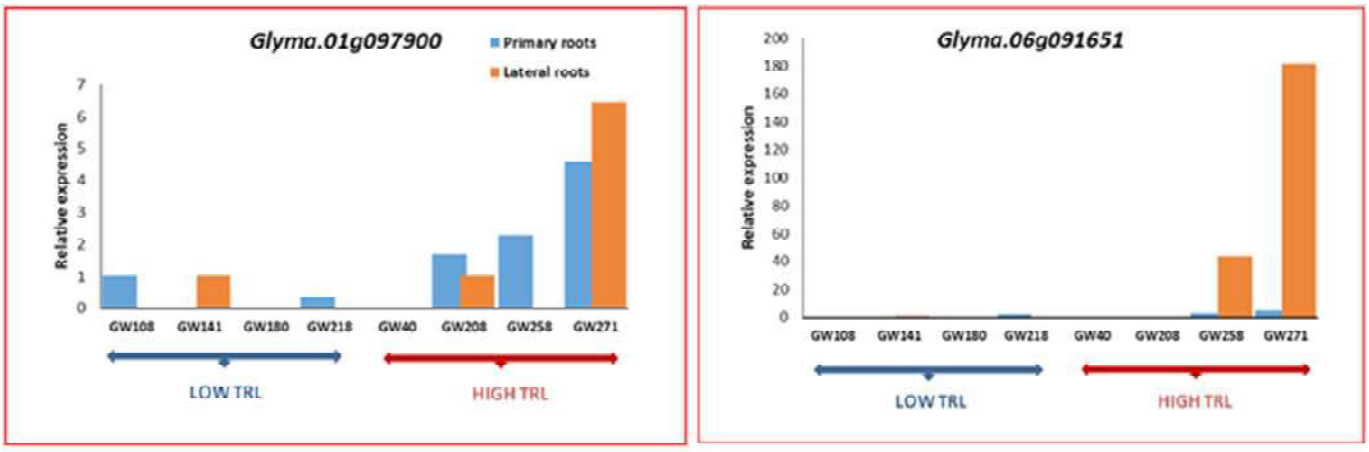


Figure 3.3.8: Differentially expressed *SOR1* like genes in contrasting lines for root length

3.4 Management of Biotic Stresses

IISR1.33/16: Development of YMV resistant soybean varieties using marker assisted selection

PI: Anita Rani, Co-PIs: Vineet Kumar and B.S Gill

YMV resistant and high oil entry NRC 259, developed using MAS has been promoted to AVT 1 in the Central Zone. Two YMV resistant entries NRC 259 and NRC 260 developed using MAS have been retained in IVT of North East Hill Zone for second year evaluation. F_7 of NRC142 (double null) x NRCSL2 (YMV resistant EDV of JS335) were raised in *Kharif* and progeny rows possessing YMV resistance gene were tested at Hot spot Ludhiana. F_7 of NRC142 (double null) x NRCSL2 (YMV resistant EDV of JS 335) were raised in *Kharif* and seeds of high yielding lines were tested for the presence/absence of KTI using native PAGE and presence/absence of lipoxygenase 2 activity using rapid assay. F_7 of NRC142 (double null) x BC_3 of JS95-60 x (JS95-60 x SL 525) (YMV resistant) were raised in *Kharif* and progeny rows possessing YMV resistance gene were tested at Hot spot Ludhiana. The seeds of high yielding resistant lines were tested for the presence/absence of KTI using native PAGE and presence/absence of lipoxygenase 2 activity using rapid assay. BC_2F_1s of cross AMS 100-39 x (NRC149 x AMS100-39) were raised in the off season and BC_2F_2s were raised in *Kharif* in the field. Advance breeding lines with YMV resistance genes were planted in the fields of PAU,Ludhiana (hot spot for YMV) for validation of YMV resistance.

IISR 3.11b/18: Soybean improvement against charcoal rot and anthracnose diseases

PI:V. Nataraj, Co-PIs: L.S Rajput, Sanjeev Kumar, Shivakumar, M, V. Rajesh, P.K Amrate, M.B Ratnaparkhe and Shalini Huligol

Identification of anthracnose resistance sources

Twelve soybean genotypes which were found to be resistant (against Indore isolate) previously were re-evaluated using pod-inoculation method. At 3dai (days after inoculation), no genotype was found to be resistant. However, genotypes viz., EC 95677, JS 23-09, EC 39751, NRC 150 and JS 22-18 were found to be moderately resistant.

IISR 4.5/23: Soybean breeding for resistance against charcoal rot and anthracnose diseases

PI: V. Nataraj, Co-PIs: P.K Amrate, Sanjeev Kumar, Shivakumar, M, Vangala Rajesh and M.B Ratnaparkhe

Identification of anthracnose resistance sources

A total of 95 genotypes were evaluated for anthracnose resistance (against the most virulent isolate- MHOW isolate) using pod-inoculation method. At 3dai (days after inoculation), out of them, seven genotypes viz., NRC 130, NB 208, AGS 163A, NRC 202, NRC 152, EC 34106 and CAT 1504 were found to be resistant.

Hybridization

Table 3.4.1:Crosses made aiming at high-yielding, charcoal rot and anthracnose resistance

Cross Name	Cross Name
JS 20-38 x JS 20-34	JS 20-69 x NRC 150
NRC 181 x POP2	JS 20-69 x JS 22-18
JS 20-20 x JS 22-18	NRC 181 x YP43
JS 20-34 x JS 20-38	JS 20-34 x EC 457464
JS 20-34 x PP6	YMV 16 x POP2
NRC 150 x YMV 16	JS 20-98 x EC 34106 x JS 95-60
POP2 x JS 95-60	JS 20-20 x NRC 188
JS 20-69 x (JS 20-69 x JS 95-60)	JS 21-05 x POP2
NRC 181 x NRC 142	JS 22-18 x POP2
EC 457254 x NRC 150	POP2 x PS 1569
JS 21-05 x JS 22-18	JS 22-18 x NRC 188
NRC 127xEC 34372	JS 20-98 x PP6
NRC 142 x NRC 150	NRC 127 x NRC 150
EC 18596 x JS 20-34	YMV 16 x NRC 150
EC 18596 x NRC 150	JS 20-69 x JS 95-60
JS 22-18 x PP6	JS 20-20 x POP2
NRC 150 x POP2	YP 49 x NRC 188
JS 20-98 x NRC 150	JS 20-98 x EC 18596
1289560F6 x JS 95-60	JS 20-34 x POP2
NRC 142 x 1289560F6	PS 1569 x JS 20-34
POP2 x NRC 142	JS 22-12 x POP2
1289560F6 x POP2	NRC 150 x JS 20-34

Evaluation of half-sib families for high-yielding and anthracnose resistance

Three half-sib families (F_3) viz., JS 20-98 × JS 95-60 (N=265), EC 34372 × JS 95-60 (N=95) and JS 20-34 × JS 95-60 (N=43), and three half-sib families (F_4) viz., JS 20-98 × JS 95-60 (N=265), EC 34372 × JS 95-60 (N=95) and JS 20-34 × JS 95-60 (N=43) were evaluated for yield attributing traits and anthracnose resistance. Superior plants were selected and will be further evaluated in the next season.

Off-season generation advancement

During summer 2023, two RIL populations viz., JS 20-98 × JS 95-60 (N=350) and JS 20-34 × JS 95-60 (N=95) were advanced to F_4 and F_5, respectively.

Table 3.4.2:List of F_1 crosses advanced to F_2during rabi 2023

S.No	Cross	S.No	Cross
1	NRC 150 × YMV 16	9	JS 20-20 × JS 22-18
2	JS 20-34 × PP6	10	NRC 142 × NRC 150
3	YMV 16 × NRC 150	11	NRC 181 × NRC 142
4	NRC 181 × POP2	12	JS 20-69 × (JS 20-69×JS 95-60)
5	NRC 127 × EC 34372	13	JS 20-69 × JS 95-60
6	JS 20-38 × JS 20-34	14	JS 20-98 × JS 20-38
7	POP2 × JS 95-60	15	EC 457254 × NRC 150
8	JS 20-34 × POP2	16	JS 21-05 × JS 22-18

DST-SERB: Genomic strategies for improving anthracnose resistance in soybean (*Glycine max* L)

PI: MilindRatnaparkhe, Co-PIs: Nataraj V., Giriraj Kumawat, Shivakumar M, Laxman Singh Rajput, Subhash Chandra

GWAS analysis for anthracnose resistance

Soybean anthracnose is a prominent foliar disease of soybeans and causes loss in productivity by damping-off and stem lesions. Limited information is available regarding the resistant genes molecular markers and their locations. In this view, we conducted a GWAS analysis to identify significant SNPs associated with anthracnose resistance.

The GWAS involved 269 soybean genotypes, utilizing the FARMCPU and BLINK models within the GAPIT tool in R. Diversity analysis showed six different groups in phylogenetic tree and population structure (figure 3.4.1). The analysis focused on anthracnose resistance-related traits, including PDI (scores recorded after 48 and 72 hours of pod inoculation), LI (scores recorded after 72 hours), and AUDPC (Area Under Disease Progress Curve), derived from leaf inoculation data. The GWAS analysis revealed significant loci on chromosomes 16, 18, and 19, associated with a specific set of SNPs (Figure 3.4.2). Furthermore, the lead SNPs identified a cluster of NBS-LRR genes on chromosome 16.

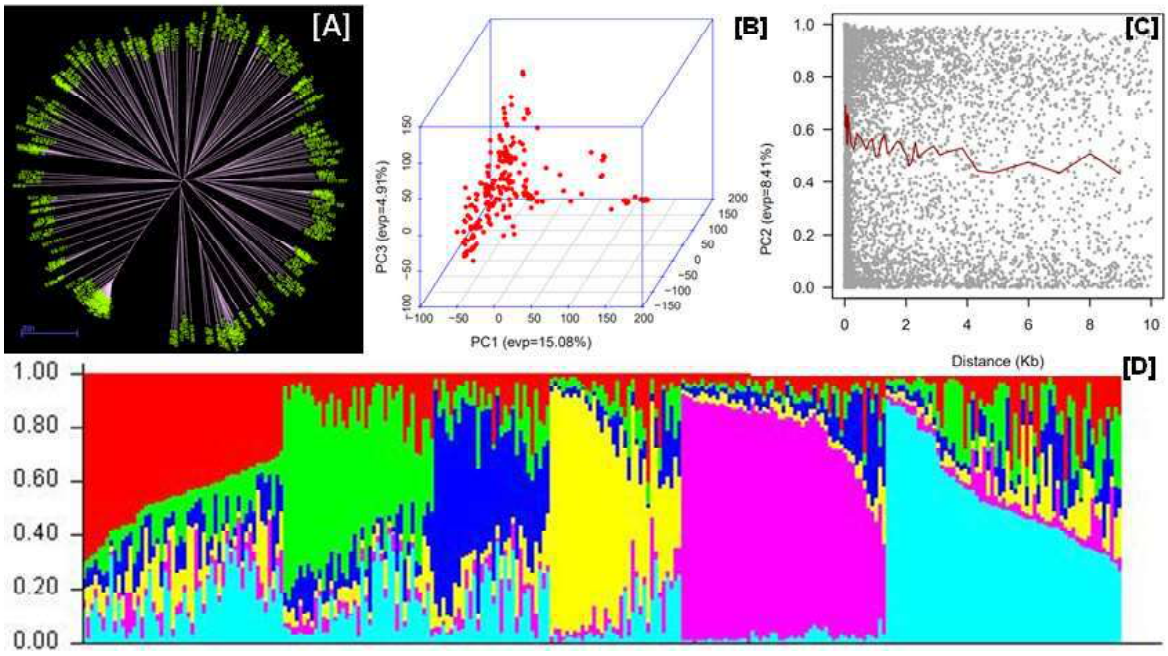


Figure 3.4.1: Diversity analysis using SNPs for GWAS panel of soybean. Phylogenetic treeof 269 soybean germplasm lines used (A), Principle component analysis (B), Pair of SNPs were compared to determine significant LD (C), Population structure (D), Six different groups were seen in Phylogenetic tree and Population structure.

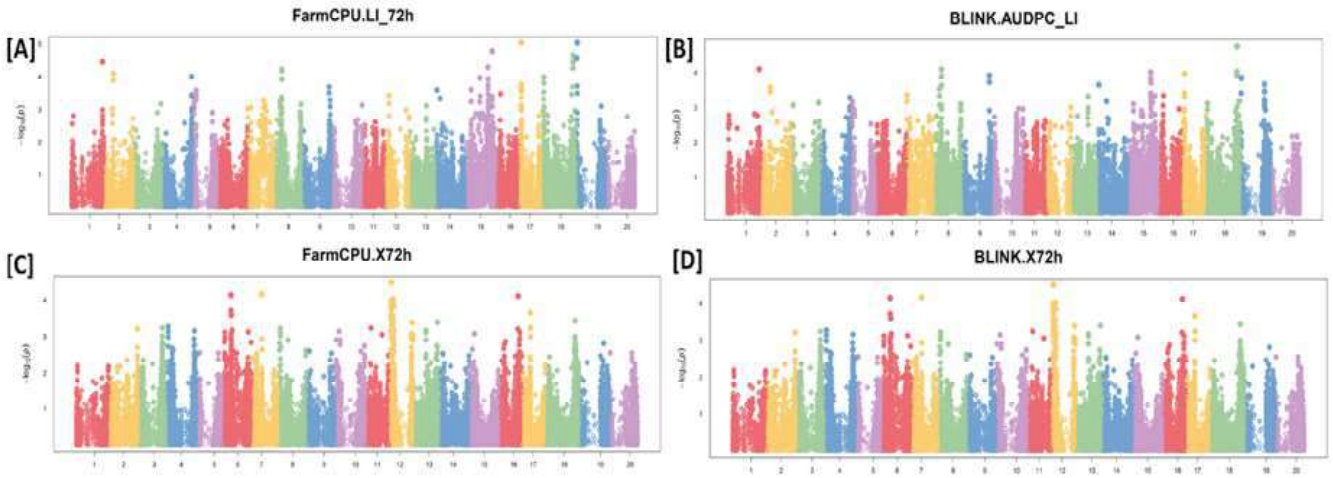


Figure 3.4.2: Association of SNPs derived from GWAS panel for anthracnose resistance. Manhattan plot showing significant SNPs associated withanthracnose resistance related traits. PDI, Score recorded after 48 and 72 h of pod inoculation; LI, Score recorded after 72 h. AUDPC, Area Under Disease Progress Curve derived from leaf inoculation data.

IISR 3.11/22: Soybean improvement against Rhizoctonia aerial blight disease

PI: Sanjeev Kumar, Co-PIs: V. Nataraj, Shivakumar M, M.B. Ratnaparkhe, K.P. Singh, Pezangulie Chakruno and PawanAmrate

A total of 42 *Rhizoctonia solani* isolates causing RAB disease were collected from different soybean growing regions of India. Based on radial growth, RS3(Sehore), RS34(Bindukhatta), RS35(Kamlawaganja) were fast growing isolates, whereas, RS21(Hoshangabad), RS22(Khargone) and RS39 were found to be slow growing. These isolates produced varying mycelial colors, *viz.,* white, yellowish white and reddish brown color. The mycelial growth was found to be either aerial or sub aerial. All the isolates produced sclerotia varying in colour either black rough or smooth white, however, some isolates viz., RS21 (Hoshangabad), RS22 (Khargone), RS33 (Chhindwara), RS37 (Depalpur), RS41(Dewas) and RS42 (Jaipur) produced no any sclerotia (Figure 3.4.3).

The PCA biplot analysis of different morphological characters showed PC1 was 51.29 % and PC2 was 26.33 %, showing a cumulative variance of 77.62 %. Among the parameters, the sclerotial number followed by the sclerotial size parameter showed maximum contributions. Similarly, among fungal isolates maximum variance showed by RS21, RS39, RS37, RS38, RS36, RS11, RS40, RS7, RS42, RS6, RS10, RS35 in a decreasing order. PCA biplot showed that sclerotial size positively correlated with RS9, RS24, RS1, RS4, RS34, RS2, and RS31. Radial growth was positively correlated with RS38 and RS3. Similarly, the sclerotial number was positively correlated with RS6, RS26, RS40, RS10 and RS36 fungal isolates (Figure 3.4.4).

Figure 3.4.3: Morphological growth of *R. solani* isolates collected from different geographical regions

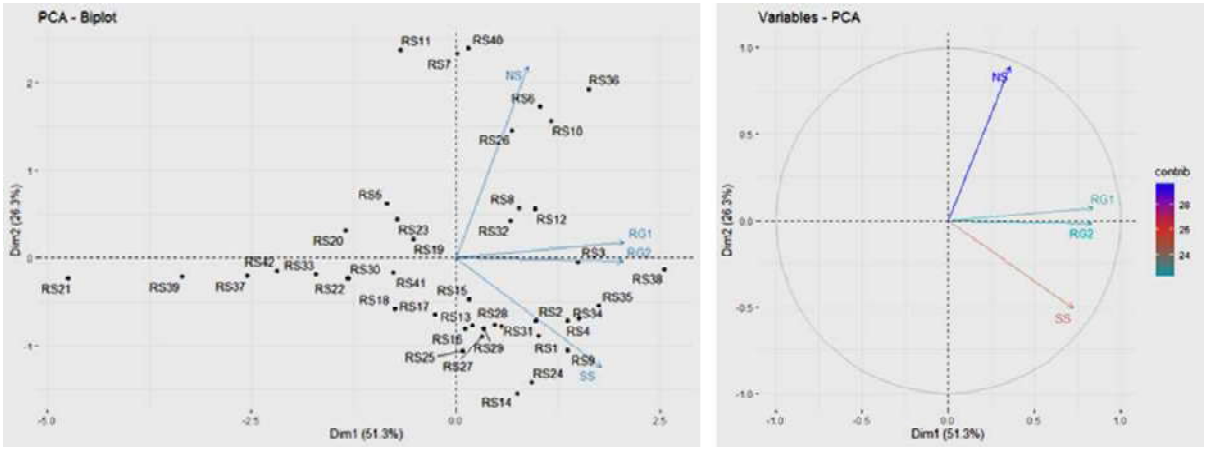


Figure 3.4.4: PCA biplot analysis of different morphological characters of 42 *R. solani* isolates.

IISR 3.12/19: Soybean Improvement against defoliating insects

PI: Vangala Rajesh, Co-PIs: Lokesh Kumar Meena, Shivakumar M, Vennampally Nataraj, Milind Ratnaparkhe

Screening of soybean accessions for defoliating insects resistance

About 106 black soybean germplasm lines were screened in field and lab conditions against defoliating insects (*Spodoptera litura*) in RBD.In lab conditions, based on preference index (C) of antixenosis for *Spodoptera litura*, soybean accessions were categorized based on the resistance in comparison with susceptible check as JS 335. EC 1039028 exhibited strong antixenosis whereas 4 genotypes Viz., JS (SH) 131, EC 589407, AGS 160 and IC 24997 exhibited moderate antixenosis.

Twenty five F_1 crosses including 9 interspecific crosses (*Glycine max* × *Glycine soja*) were tested for antixenosis against *Spodoptera litura*. Four F_1 intraspecific crosses Viz., AKSS 67 x JS20-34, F4P21 × LINE 220, JS 335 × F4P21, JS 95-60 × AKSS 67 and 5 interspecific crosses viz., JS 335 × PI 407170, JS 20-34 × PI 593983, JS 95-60 × PI 593983, JS 9560 × PI 407170, JS 20-34 × PI 407170 exhibited strong antixenosis against *Spodoptera litura.*

A F_2 population derived from cross F4P21 × Line 220 (JS 335 × *Glycine soja*) which exhibited strong antixenosis in F_1 were studied for antixenosis against *Spodoptera litura* revealed considerable variation among the population and revealed polygenic in nature (Quantitative trait).

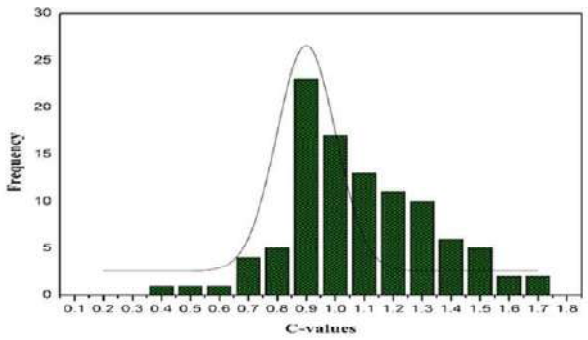


Figure3.4.5: A F_2 population of F4P21 × Line 220 (JS 335 X *Glycine soja*) depicting continuous variation of polygenic trait

Evaluations of soybean genotypes for stem fly and girdle beetle resistance

A set of 106 black soybean germplasm lines were screened in field conditions for stemfly and girdle beetle resistance. In case of stemfly, 9 genotypes Viz., UPSM 593, KT RAMESHWAR, EC 102322, PK 564, UPSM 579, PUSA 97-03, EC 232075, AGS 113, EC 389164 exhibited moderate resistance, 8 genotypes viz., TAX 34251, EC 389164, TAX 34251, PSLO 92, J 563, J 473, EC 1039108, AGS 108, AGS 60, IC 498621 were susceptible whereas EC 1039035 was highly susceptible.In case of girdle beetle, 16 genotypes viz., BLACK BOLD, EC 457066, UPSM 314, BHATT BLACK KURSA, EC 100804, RPSP 722, PP 26, PK 1005, UPSM 600, NRC-2 (CAT 2069), UPSM 1087, EC 251886, UPSM 640, UPSM 445, UPSM 700, UPSM 445, UPSM 700, UPSM 653 were found to be moderately resistant whereas PK 515 was highly susceptible.

Generation advancement and selection

Fourteen crosses viz., AGS 155 x AKSS 67, JS 97-52 x (JS20-34 X Line 202), F4P21 × Line 220, Harasoya x JS 9305, Harasoya x (F4P21 × Line 220), G5P22 x JS 335, JS 335 x F4P21, F3P18 x JS 335, JS 20-34 x G5P22, F4P21 × Line 202, F3P18 x Line 202, JS 9560 x Line 220, RKS 113 x SL 1104, JS 20-34 x Line 220 were advanced to F_3 generation by SPD method.

Antixenosis and antibiosis reaction of soybean genotypes against *Spodoptera litura*

PI: Lokesh Kumar Meena,Co-PI: Vangala Rajesh

Antixenosis and Antibiosis studies were done on *Spodoptera litura* on different soybean genotypes (AVT-II). Antixenosis studies were conducted on 10 soybean genotypes against *Spodoptera litura* based on Preference Index and classified the varieties based on reference values. Based on the reference values of all genotypes none of the genotype was found strong/ extreme antixenosis. In antibiosis studies on these selected 10 genotypes, the larvae reared on genotype EAE-23-83 found the lowest AD (68.69%). The lowest ECI value was found in EAE-23-82 (61.54%). The lowest ECD value was found in EAE-23-84 (82.70%). The lowest wt. of per pupae was found in lowest in EAE-23-80 genotype (0.120 mg), respectively.

IISR 3.1/21: Isolation and identification of kairomones and sex pheromones components for soybean stem fly, *Melanoagromyza sojae* management

PI: Lokesh Kumar Meena Co-PIs: Vangala Rajesh and Kamala Jayanthi

To find the most attractive crop for stem fly mass rearing, five crops were raised. The results of this experiment indicated that the maximum stem tunneling was made by stem fly larva in soybean crop (15.77%) followed by Black gram (9.50%). The rest of the crop stem tunneling were found in the following descending order- Green gram (2.74%) > Cow pea (2.61%) > French bean (2.09%).Screening of 50 soybean germplasm was done for identification of resistant and susceptible soybean genotypes against stem fly. Out of fifty genotypes, seventeen genotypes viz., IC 0421898 (45.45% stem tunneling), IC 0421898 (57.79 % stem tunneling), EC 113396 (54.18 % stem tunneling), IC 469833 (58.74% stem tunneling), IC 02128917 (61.80% stem tunneling), IC 0501788 (56.94% stem tunneling), IC 0118437 (63.31% stem tunneling), EC 0251843 (58.39% stem tunneling), IC 0262123(48.26% stem tunneling), IC 0548636 (57.70% stem tunneling), EC 0287458 (60.06 % stem tunneling), IC 0032730 (49.31 % stem tunneling), EC 39570 (46.94 % stem tunneling), IC 49857 (76.06 % stem tunneling), EC 0291396 (50.54% stem tunneling), IC 0501852 (45.22% stem tunneling) and IC 0117395 (46.09% stem tunneling) were found highly susceptible (HS) to stem fly and they can be used for mass multiplication suitably for stem fly.

Body volatiles of both males and females separately were collected by using diethyl ether as solvent. For this purpose 50 males and 50 females were taken. The body volatiles of insects were collected and olfactometer bioassay, GC-MS analysis and Electrophysiology studies were done. Leaf volatiles of 5 genotypes viz., F4P21, F3P18, CAT2503, JS 9560 and JS 335 soybean genotypes were collected and olfactometer bioassay, GC-MS analysis and Electrophysiology studies were done.

Evaluation of Bio-efficacy of some newer insecticides against whitefly

PI: Lokesh Kumar Meena

Nine newer insecticides viz., Thiamethoxam 25 % WG, Thiamethoxam 75 % SG, Acetamiprid 20% SP, Emmamactin benzoate 5% SG, Chlorantraniliprole 18.5% SC, Thiacloprid 21.7% SC, Propargite 57% EC, cyantraniliprole 25% EC etc. along with control were tested for their bio-efficacy against major insect-pests of soybean under field conditions for three years. Among them, Thiamethoxam 25 % WG was found most effective followed by Thiamethoxam 75 % SG after two sprays of these insecticides.

3.5 Seed Quality Characteristics

IISR 1.35/17: Improvement in soybean seed viability and strength of seed coat by genetic amelioration of seed coat traits

PI: Punam Kuchlan, Co-PI: Mrinal Kuchlan and Sanjay Gupta

Vegetable soybean has to be improved in seed germination potential and adaptability. Vegetable variety Karune has very poor seed germination (40%), highly susceptible to Rhizoctonia Aerial blight and anthracnose diseases and having slow seed development rate in pod. To address this problem vegetable variety Karune was crossed with EC 538828 (yellow bold seeded with rapid seed development and resistance to multiple diseases) and developed 460 RIL population. RIL's were evaluated on the basis of sensory taste at vegetative stage whereas, disease resistance and seed size at vegetative and mature stage along with seed germination potential.Generation advancement of crosses Karune x EC 538828, Karune x VC111 and Karune x VC109 populations were done in *Kharif* 2023.

Vegetable soybean breeding lines were screened for field emergence rate, bold seededness, number of days to picking the pods, Total Soluble Sugar content (%) at green stage, presence /absence of pubescence on pod, pod size, protein content at green stage, disease resistance/tolerant to diseases and taste after cooking the selected vegetable lines were evaluated. High germination lines were identified on the basis of field emergence rate. The immature pods of vegetable soybean are picked as the plants reach approximately 80% of maturity (between reproductive stages of R6 and R7) and still retain about 65% moisture content. Among good germination lines the vegetable type parameters are being tested like sweet taste (organoleptic), TSS content, bold seed with big pod size, presence and absence of pubescence etc., green pods were picked in four different slot i.e., (70 days,76 days, 87 days and 92 days). From the RILs of Karune x EC 538828, one line with 4 times picking and 21 lines with 2 times picking were identified which was found sweetest in taste.

Based on sensory taste 12 lines were selected from the RILs of KARUNE × VC 111. All 12 lines had high field emergence of more than 80 percent and out of 12 good taste 6 lines had high Total Soluble Sugar content (>30% brix). A total of 101 lines of cross Karune xVC109 were evaluated and 11 lines were selected on the basis of good taste and high field emergence rate > 80 % with free from disease infection. Out of 11 lines, 4 lines are having high TSS content >30% brix.

Table 3.5.1:Details of RILs of vegetable type soybean (Karune x EC538828)

Selecting characters	Numbers
Total selected line sown	359
Very good germination (> 85%)	58
Good germination (75-85)	143
Poor germination (50-65%)	158
Lines susceptible to Rhizoctonia Arial Blight	136
At picking stage (green stage) 100 seed weight	27.54 - 75.01g
Pod size at green stage	5.0-7.5 cm
Puberlent pod (pubescence almost absent)	161 lnes
Pod with pubescence	188 lines
TSS >30% brix	68 lines

Table 3.5.2: Details of sweetest vegetable line measured (after Sensory taste) at picking stage 70 DAS.

S.NO.	LINE NO.	TSS %	Protein % at green stage	Field emergence rate	Pubescence on pod	Disease Presence (RAB & anthracnose)
1	6	30	34.8	85	Absent	-
2	24	36	30.9	82	Absent	-
3	56	36	38.1	71	Absent	-
4	59	37	32.5	88	Absent	-
5	61	28	30.3	83	Absent	-
6	64	28	30.8	90	Absent	-
7	128	27	31.7	80	Present	+
8	134	35	34.1	84	Absent	-
9	146	35	38.9	83	Absent	-
10	152	30	33.2	83	Absent	-
11	177	30	34.9	87	Absent	-
12	178	28	30.0	90	Absent	-
13	232	24	34.9	85	Absent	-
14	303	28	28.1	81	Absent	+
15	328	33	34.6	84	Present	+
16	332	28	31.2	80	Present	-
17	333	31	28.7	74	Absent	-
18	335	35	40.1	79	Absent	-
19	355	20	32.5	86	Absent	-
20	356	19	33.7	88	Absent	-
P1	Karune	33	34.2	45	Absent	+
P2	EC538828	29	37.3	85	Absent	-

* TSS (Total Soluble Sugar/ Total Soluble Solid) was measured (after Sensory taste)

* Picking stage for TSS = 70-72 DAS

Fig 3.5.1: RILs of vegetable soybean with variability of pod pubescence-dense, sparse, glabrous

Maintenance of soybean released and notified varieties as reference collection at IISR-Nodal Centre of DUS Testing

PI: Mrinal Kuchlan

One fifty six released and notified soybean varieties were maintained during *Kharif*2023 at IISR, Indore. The varieties were characterized for 20 DUS Test characteristics. Due to adverse climatic condition (Long dry spell during Aug and high rainfall during Sept) affected performance of soybean varieties significantly. The effect of climatic factors is reflected in terms of yield. The yield performance varied from 1.39 q to 35.58 q. 13 varieties yielded above 30q/ha, 14 varieties more than 25-30q/ha, 12 varieties between 20 – 25 q/ha, 27 varieties between 15- 20q/ha, 34 varieties between 10 15 q/ha, 39 varieties between 5 - 10 q/ha and 15 varieties produced less than 5 q/ha.

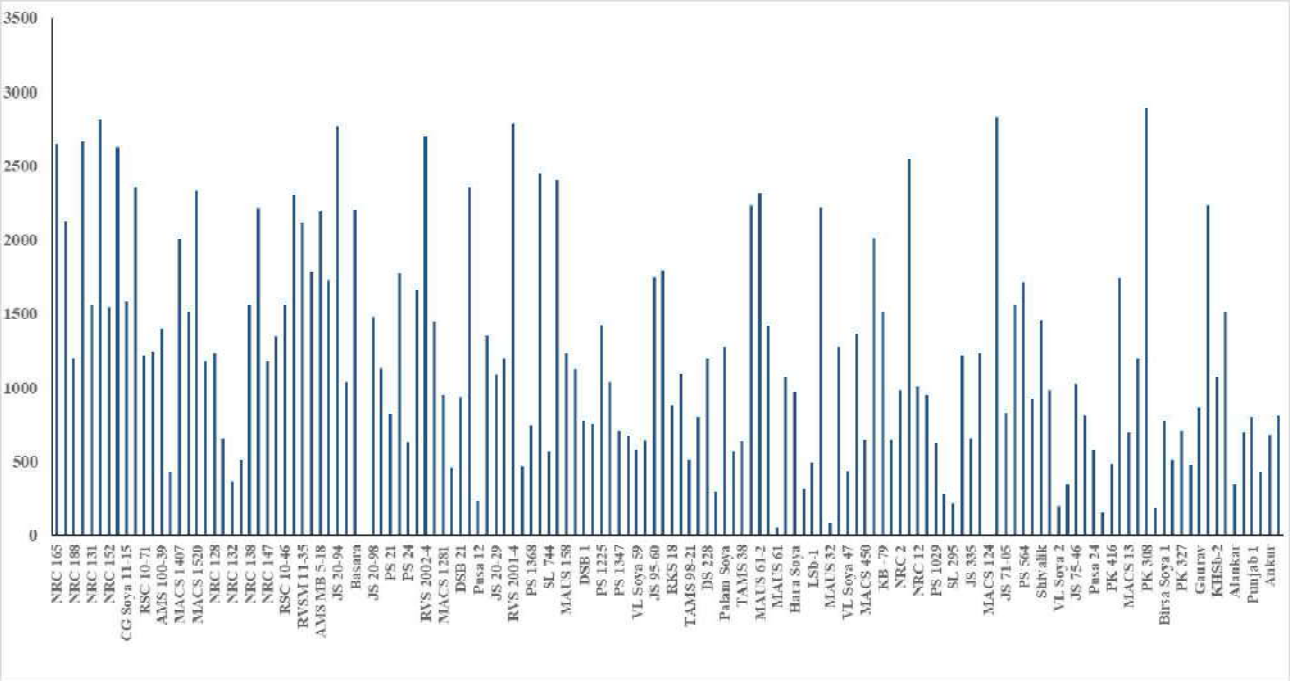


Figure 3.5.2: Performance of different soybean varieties during *Kharif* 2023

Soybean seed production and marketing during 2022-23 under AICRP Seed (Crops) and Seed Hub Project on Oil seeds

PI: Mrinal Kuchlan

Breeder seed production

Soybean breeder seed production of different varieties namely NRC 142, NRC 138, NRC 130, NRC 128, NRC 136, NRC 86 and RVS 24 was undertaken under AICRP Seed (Crop) at ICAR-IISR,Indore, ICARDA and in farmers field in an area of 70 ha..

Table 3.5.3 The variety wise details of breeder seed production

S. No.	Variety	Production (quintal)
1	NRC 130	86.6
2	NRC 127	38.9
3	NRC 128	20
4	NRC 138	113.8
5	NRC 142	212.5
6	NRC 136	3.1
7	NRC 86	23.1
8	RVS 24	7.8
9	NRCSL 1	0.8
10	NRC 150	3.15
	Total	509.75
	Total revenue (In Rs.)	5580165

Foundation, Certified and TL seed production

Seed production of Foundation, Certified and TL classes for NRC 142, NRC 130, NRC 138 and JS 20-69 was taken up under Seed Hub Project in collaboration with progressive farmers of Indore and Ujjain.

Table 3.5.4: The details of seed production of new varieties

Foundation seed production and marketing		
S. No.	**Variety**	**Production (quintal)**
1	NRC 142	21.3
2	NRC 138	14.1
3	NRC 130	8.7
4	JS 20-69	111.6
	Total	**155.7**
Certified Seed Production and marketing		
S. No.	**Variety**	**Production (quintal)**
1	JS 20-69	475.56
	Total	**475.56**
TL Seeds Production and marketing		
S. No.	**Variety**	**Production (quintal)**
1	JS 20-69	66.9
2	NRC 142	75
	Total	**141.9**
	Grand Total	**773.2**

3.6 Crop Production Technologies

IISR4.13/17 Evaluation of residue management practices under permanent broad bed furrow as well as conventional tillage practices for sustaining/ improving resources use efficiency, soil quality and crop productivity in soybean-based cropping systems

PI: Rakesh K. Verma, Co-PIs:Raghavendra Nargund, A. Ramesh, M. P. Sharma and Prince Choyal

The field experiment was conducted during *Rabi* 2022-23 and *Kharif*, 2023 to evaluate the effect of cropping systems, crop establishment's method and residue management practices on yields of soybean-based cropping systems. Experiment was laid out in split plot design with three cropping systems (soybean-potato-wheat, soybean-wheat and soybean-chickpea) in main plot and four crop establishments method [permanent broad bed furrow with residue (PBBF + R), permanent broad bed furrow without residue (PBBF + WR), conventional tillage as per farmer's practices with residue (CTFP + R), and conventional tillage as per farmer's practices without residues (CTFP + WR)] in sub plot. The 50% of the soybean crop residue was retained in the field to subsequent *rabi* crops, 50% of the gram and 30% of the wheat crop residue to subsequent *Kharif* crop.The rabi 2022-23 results revealed that, significantly higher yield of wheat (12.4%), potato (38.8%), wheat after potato (44.6%) and chickpea (16.6%) were registered under PBBF + R as compared to CTFP + WR (Table 3.6.1). Whereas in *Kharif* 2023 cropping systems did not influence significant improvement in soybean yield and cost: benefit ratio. However, 17.5% soybean yield increase and highest B:C ratio (4.04) were observed with PBBF + R as compared to CTFP +WR (Table 3.6.2). Further, highest soybean equivalent yield and net returns were registered under soybean-potato-wheat system as compared to remaining cropping systems. Among the different land configurations significantly the higher soybean equivalent yield, net returns, and B:C ratio were found under PBBF+R as compared to other land configuration practices (Table 3.6.3).

Table 3.6.1: Effect of cropping systems, crop establishment's method and residue management practices on yields of rabi season crops

Treatment	Rabi season crop yields (kg/ha)			
	Potato	Wheat	Wheat yield after potato	Chickpea
Land configurations and residue management practices				
PBBF + R	17129^{a}	5868^{a}	4649^{a}	1563^{a}
PBBF +WR	15501^{b}	5517^{ab}	3552^{b}	1387^{b}
CTFP + R	15431^{b}	5407^{b}	3390^{bc}	1384^{b}
CTFP + WR	12345^{c}	5222^{b}	3214^{c}	1340^{b}

Table 3.6.2 : Effect of cropping systems, crop establishment methods and residue management practices on yields and economics of soybean

Treatment	Seed yield (kg/ha)	Biological yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross Return (Rs/ha)	B : C Ratio
Cropping systems					
Soybean-potato-wheat	3057[a]	5392[a]	30592[a]	143555[a]	3.70[a]
Soybean-chickpea	3113[a]	5484[a]	30592[a]	146151[a]	3.79[a]
Soybean-wheat	2914[b]	5162[b]	30592[a]	136866[b]	3.48[b]
Crop establishment methods/land configurations (LC)					
PBBF + R	3237[a]	5716[a]	30187[c]	152021[a]	4.04[a]
PBBF + WR	3201[a]	5671[a]	29197[d]	150314[a]	4.00[a]
CTFP + R	2921[b]	5149[b]	31987[a]	137131[b]	3.29[b]
CTFP + WR	2754[c]	4849[c]	30997[b]	129297[c]	3.17[b]
ANOVA					
CS	<.0001	<.0001	-	<.0001	<.0001
LC	<.0001	<.0001	<.0001	<.0001	<.0001
CS*LC	0.0069	<.0001	-	0.0044	0.0047

Table 3.6.3 : Effect of cropping systems, crop establishment's method and residue management practices on yields of rabi season crops

Treatment	System cost of cultivation (?)	Gross returns (?/ha)	Net returns (?/ha)	B : C ratio	Soybean equivalent yield (t/ha)
Cropping Systems					
Soybean-wheat	61387[b]	210357[b]	148971[b]	3.43[a]	4.28[b]
Soybean-potato-wheat	164887[a]	470871[a]	305984[a]	2.86[b]	10.49[a]
Soybean-chickpea	58942[c]	156727[c]	97785[c]	2.68[c]	3.45[c]
Land configurations and residue management practices					
PBBF + R	93664[c]	312311[a]	218647[a]	3.36[a]	6.83[a]
PBBF +WR	91830[d]	281262[b]	189431[b]	3.12[b]	6.11[b]
CTFP + R	99363[a]	275136[b]	175773[b]	2.76[c]	5.98[b]
CTFP + WR	95428[b]	248565[c]	153136[c]	2.71[c]	5.38[c]

IISR6.10/23 Standardization of natural farming practices for soybean based cropping systems

PI: Raghavendra Nargund, Co-PIs: R. K. Verma, A. Ramesh, M. P. Sharma, L.K. Meena, Sanjeev Kumar and Hemant S Maheshwari

Inflating chemical fertilizer prices, ecological threats, food and feed contamination due to high chemical intensive agricultural practices can be restrained through natural farming practices in different crops and cropping systems. Therefore, ICAR-IISR, Indore, has initiated field experiment on natural farming in soybean based cropping systems during *Kharif* 2023. The experiment was laid out in split plot design with five sustainable agriculture management practices (Natural farming, organic farming, integrated crop management, conservation agriculture and conventional agriculture practices) in main plot and three cropping systems (Soybean-chickpea, soybean-wheat and soybean-mustard) in subplot. Under natural farming employed a set of ecological approaches includes seed treatment with Beejamritha, soil application of Ghanajeevamritha, foliar application of Jeevamritha, green manuring with Dhaincha in summer, mulching, need based hoeing and Agniastra spray. The experiment is in the initial year and still we are standardizing natural farming practices for soybean and subsequent crops in sequence (Figure 3.6.1).

Figure 3.6.1: Natural farming practices followed under soybean based cropping systems

IISR9.11/20 Field evaluation of potential plant growth promoting *Rhizobacteria* (Microbial Consortia) and AM fungi on nutrient dynamics and mineral biofortification under soybean –wheat cropping system

PI: A. Ramesh, Co-PIs: M.P. Sharma and Raghavendra Nargund

A field experiment was conducted with co-inoculation of promising plant growth rhizobacteria with AM fungi on yield, nutrient uptake and changes in soil available nutrient content under soybean-wheat system. Result found that, microbial inoculation with *Bacillus aryabhattai* + *Bradyrhizobium lioningense* +AMF significantly increased macro and micronutrients uptake in straw (Table 3.6.4). Higher seed yield was observed with the inoculation of *Bacillus aryabhattai* + *Bradyrhizobium lioningense* +AMF, *Burkholderiaarboris*+ *Bradyrhizobium lioningense* +AMF and *Bacillus aryabhattai* +AMF in both soybean and wheat (Table 3.6.5). Soil available nutrients were significantly increased with inoculation of *Bacillus aryabhattai* + *Bradyrhizobium lioningense* + AMF and *Burkholderia arboris* + *Bradyrhizobium lioningense* + AMF (Table 3.6.6).

Table 3.6.4 PGPR and AMF on changes in nutrient uptake in straw of soybean

Treatment	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (kg/ha)	Zn (g/ha)	Fe (g/ha)
Control	11.7^{g}	2.19^{e}	42.26^{c}	4.45^{de}	71.95^{g}	246.80^{j}
Burkholderia arboris	16.3^{cd}	2.51^{d}	51.81^{ab}	5.37^{bc}	92.78^{ef}	288.95^{gh}
Bacillus aryabhattai	15.3^{de}	2.85^{bc}	53.33^{ab}	4.76^{cd}	103.61^{cd}	297.70^{fg}
Bradyrhizobium lioningense	13.5^{f}	2.19^{e}	40.84^{c}	4.07^{e}	58.34^{h}	264.69^{i}
Burkholderia arboris + *Bradyrhizobium lioningense*	15.4^{de}	2.79^{cd}	53.83^{a}	5.35^{bc}	95.90^{def}	303.19^{ef}
Bacillus aryabhattai + *Bradyrhizobium lioningense*	14.0^{ef}	2.79^{cd}	46.09^{bc}	5.39^{bc}	100.86^{cde}	317.76^{cd}
Burkholderia arboris + AMF	18.6^{ab}	3.18^{a}	50.31^{ab}	4.59^{de}	106.26^{c}	311.93^{de}
Bacillus aryabhattai +AMF	17.1^{bc}	3.34^{a}	51.94^{ab}	4.61^{de}	116.20^{b}	332.58^{b}
Bradyrhizobium lioningense +AMF	12.9^{fg}	2.51^{d}	42.88^{c}	4.17^{de}	87.22^{f}	281.61^{h}
Burkholderia arboris + *Bradyrhizobium lioningense* + AMF	15.2^{de}	3.11^{ab}	50.56^{ab}	6.67^{a}	116.06^{b}	326.48^{bc}
Bacillus aryabhattai + *Bradyrhizobium lioningense* + AMF	20.0^{a}	3.36^{a}	52.03^{ab}	5.86^{b}	126.46^{a}	346.77^{a}
LSD (p = 0.05)	**0.66**	**0.29**	**7.32**	**0.52**	**9.72**	**10.59**

Data are mean values of four replicates; means with different letters in the same row differ significantly at P=0.05 according to Fisher LSD

Table 3.6.5 : PGPR and AMF on seed yield of soybean and wheat (Kg/ha)

Treatment	Soybean	Wheat
Control	1800^{e}	4597^{cd}
Burkholderia arboris	1957^{bcde}	4775^{bcd}
Bacillus aryabhattai	1992^{bcd}	4909^{ab}
Bradyrhizobium lioningense	1847^{de}	4531^{d}
Burkholderia arboris + *Bradyrhizobium lioningense*	1901^{cde}	4855^{abc}
Bacillus aryabhattai + *Bradyrhizobium lioningense*	2039^{abc}	5008^{ab}
Burkholderia arboris + AMF	1986^{bcd}	4809^{abc}
Bacillus aryabhattai +AMF	2066^{ab}	4979^{ab}
Bradyrhizobium lioningense +AMF	1837^{de}	4751^{bcd}
Burkholderia arboris + *Bradyrhizobium lioningense* +AMF	2044^{abc}	4868^{ab}
Bacillus aryabhattai +*Bradyrhizobium lioningense* +AMF	2168^{a}	5044^{a}
LSD(p =0.05)	**160.86**	**265.87**

Data are mean values of four replicates; means with different letters in the same row differ significantly at P=0.05 according to Fisher LSD

Table 3.6.6 : PGPR and AMF on changes in available nutrient content (ppm)

Treatment	N	P	K	S	Zn	Fe
Control	114.38^{d}	8.64^{d}	251.13^{f}	6.51^{g}	0.57^{e}	2.88^{bc}
Burkholderia arboris	140.63^{bc}	10.04^{c}	260.38^{ef}	8.09^{b}	0.74^{bcd}	3.42^{a}
Bacillus aryabhattai	146.25^{bc}	10.1^{c}	295.5^{a}	8.92^{a}	0.8^{abc}	3.22^{ab}
Bradyrhizobium lioningense	146.25^{bc}	8.86^{d}	265.13^{def}	6.17^{h}	0.57^{e}	2.69^{c}
Burkholderia arboris + *Bradyrhizobium lioningense*	155.63^{ab}	10.68^{bc}	270.5^{cde}	6.76^{f}	0.69^{d}	2.96^{bc}
Bacillus aryabhattai + *Bradyrhizobium lioningense*	163.13^{a}	11.29^{ab}	280^{bc}	7.72^{c}	0.81^{abc}	3.36^{a}
Burkholderia arboris + AMF	136.88^{c}	10.67^{bc}	285.25^{ab}	6.82^{f}	0.72^{cd}	3.48^{a}
Bacillus aryabhattai +AMF	155.63^{ab}	11.12^{ab}	296.75^{a}	7.17^{e}	0.83^{ab}	3.51^{a}
Bradyrhizobium lioningense +AMF	155.63^{ab}	8.98^{d}	261.88^{ef}	5.86^{i}	0.59^{e}	2.93^{bc}
Burkholderia arboris + *Bradyrhizobium lioningense* +AMF	153.75^{ab}	11.54^{a}	284.5^{abc}	6.78^{f}	0.81^{abc}	3.47^{a}
Bacillus aryabhattai +*Bradyrhizobium lioningense* +AMF	163.13^{a}	11.85^{a}	277.88^{bcd}	7.45^{d}	0.83^{a}	3.5^{a}
LSD(p =0.05)	**15.83**	**0.78**	**14.09**	**0.18**	**0.09**	**0.35**

Data are mean values of four replicates; means with different letters in the same row differ significantly at P=0.05 according to Fisher LSD

IISR 3.12/20 Interaction effect of phytohormones and AMF for enhanced nodulation, growth, yield of soybean with improved AMF symbiosis in the rhizosphere

PI: M.P Sharma, Co-PIs: Prince Choyal and A. Ramesh

Response of phytohormones and *AMF* for enhanced nodulation and yield of soybean

During *Kharif* 2023, response of Triacontanol (Tria 2 ppm) and IAA (100 ppm) applied as foliar application at 25 days after sowing (DAS) with and without AMF inoculation was assessed. Results shown that, among phytohormones Tria 2ppm with AM inoculation found significantly higher nodule biomass, leghemoglobin content in nodules and grain yield (Figure3.6.2 and 3.6.3). Irrespective of phytohormone, AM inoculation has enhanced the nodulation and grain yield of soybean. However,Triacontanol (2 ppm) applied at 25 DAS further enhanced the nodulation and yield significantly.

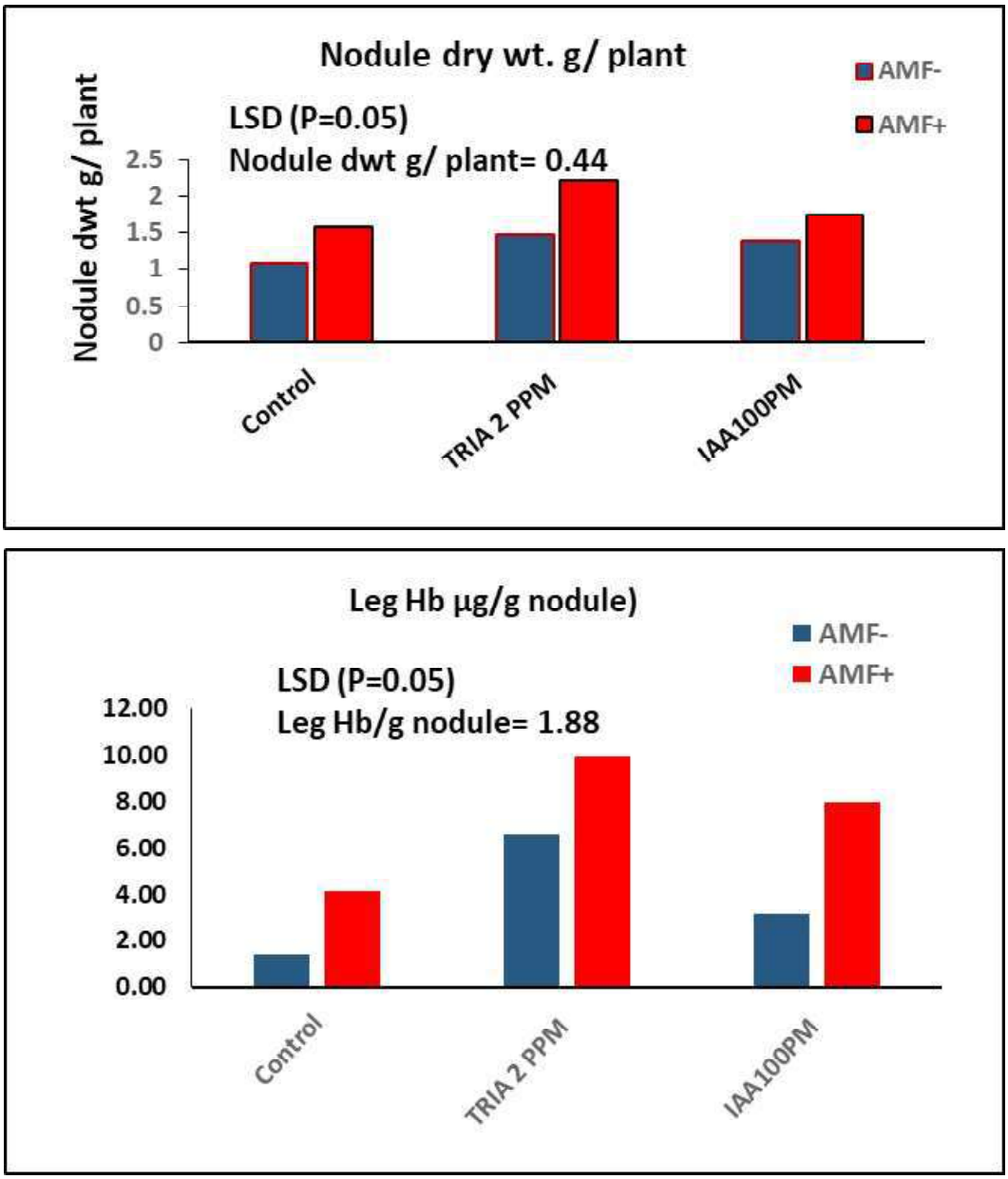


Figure3.6.2: Effect of Triacontanol and IAA (foliar application) and AM fungi on soybean nodulation assessed at flowering stage of soybean (cultivar JS 20-69)

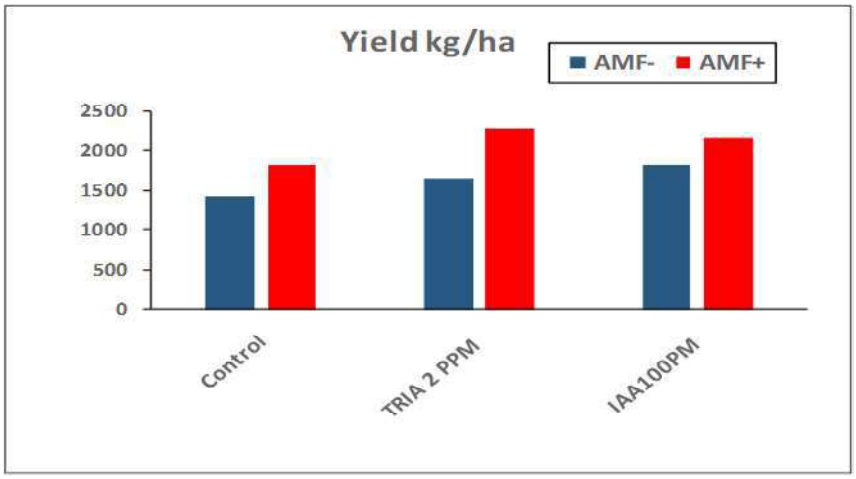


Figure 3.6.3 : Effect of Triacontanol and IAA (foliar application) and AM fungi on grain yields of soybean (cultivar JS 20-69)

Assessing the co-inoculation effect of *B. arboris* with phytohormones for enhanced production of AM fungi into soil-based organic potting substrates on sorghum

A pot experiment was conducted on sorghum with selected phytohormones and co-inoculation effect of *Bacillus arboris* with the AM fungi was assessed in terms of spore density, mycorrhizal colonization percen-tage (MCP) and soil total glomalin (T-GRP). The co-inoculation of *B. arboris* with and without phytohormones to AM fungi inoculated organic substrates has promoted AM root colonization (MCP) (Figure 3.6.4). However, comparatively phytohormones application and co-inoculation with *B arboris* to AM-pots has progressively enhanced the AM fungi biomass. Moreover, irrespective of phytohormones, the co-inoculation of *B. arboris* to AM pots was found to be more effective. Among all the phytohormes, Tria (1ppm) applied through seed treatment with *B. arboris* combination to AM pots was found to be most effective and superior over the others and has significantly enhanced the mycorrhiza production over the other treatments. The AMF colonization of inoculated pots (AMF, AMF + *B. arboris*) ranges from 25% to 55% where Tria application and co-inoculation pots showed higher colonization which ranges from 64% to 93%. However, regardless of the mode of application, seed treatment application found to be more effective as compared to foliar. Co-inoculation of *B. arboris* with phytohormones (applied either seed treatment or foliar) with AMF inoculation has significantly influenced the spore density. Irrespective of type of phytohormones the mode of application influences the spore density but found non-significantly different. Although when phytohormone (Tria) applied as seed treatment with AMF + *B. arboris* showed comparatively higher spore density and the density was significantly higher over the control plants. Overall, under both the conditions, co-inoculation of *B. arboris* has provided favorable conditions for enhancing the AM production.

In general, *B. arboris* inoculation with phytohormones to AM pots have significantly increased the glomalin in the soil as compared to non-inoculated plants. However, the effect of phytohormone was varying with the mode of application. Amongst both the hormones, Tria when applied as seed treatment to AM pots showed comparatively higher glomalin. The glomalin quantity was significantly higher in AMF pots irrespective of *B. arboris* inoculation (586.39 to 574.63µg g^{-1} soil) but decreased (4.57 µg g^{-1} soil) significantly in non-AMF pots including control (Figure3.6.5). Regardless, the mode of co-inoculation, *B. arboris* + AMF + Tria, pots have tremendously increased the total glomalin (810 µg g^{-1} soil). The interaction effects of phytohormone with the inoculation treatment and mode of application were found to be significant for total glomalin. However, irrespective of type of phytohormone, the seed treatment application has increased the glomalin production over the foliar but the response was non-significant. The root biomass has also influenced by the treatment combinations. The seed inoculation with AMF + *B. arboris*+ Br. (20.51mg^{-1} plant) produced more root biomass than to AMF + *B. arboris* + Tria (18.77 mg^{-1}plant) plants (Figure 3.6.5).

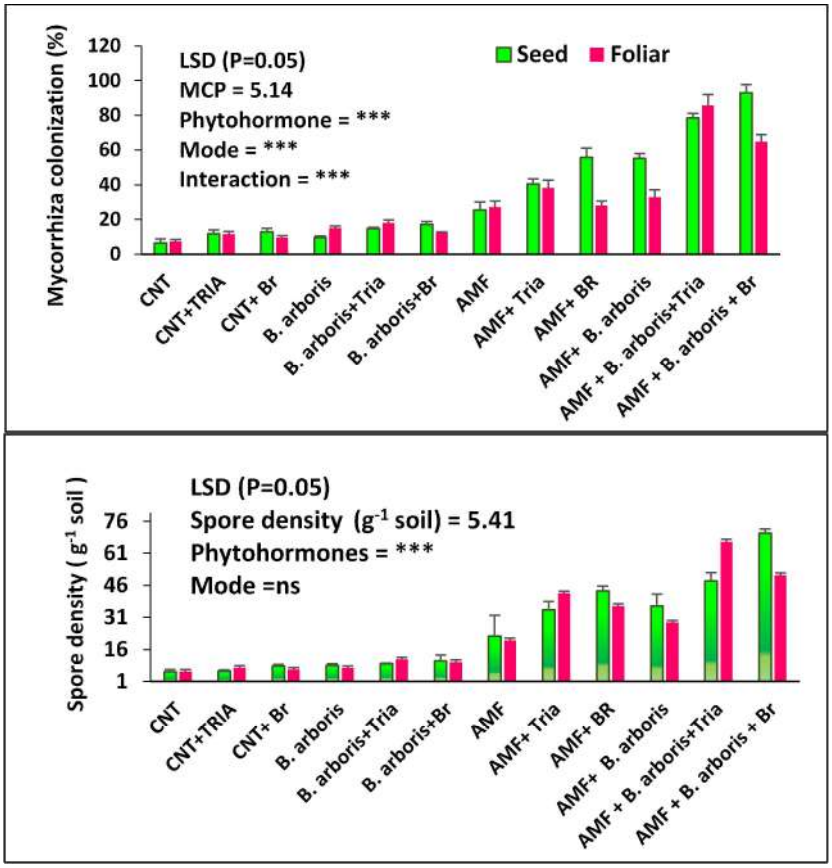


Figure 3.6.4 Integrated response of phytohormones and *B. arboris* on AM root colonization and spore density in sorghum plants grown in organic substrate amended with hulls and under unsterilized conditions. [Data are means of three replications. Vertical bars represent the standard deviation of means. LSD: least significant difference at p=0.05 for comparing the treatment means using Duncan's multiple range test]

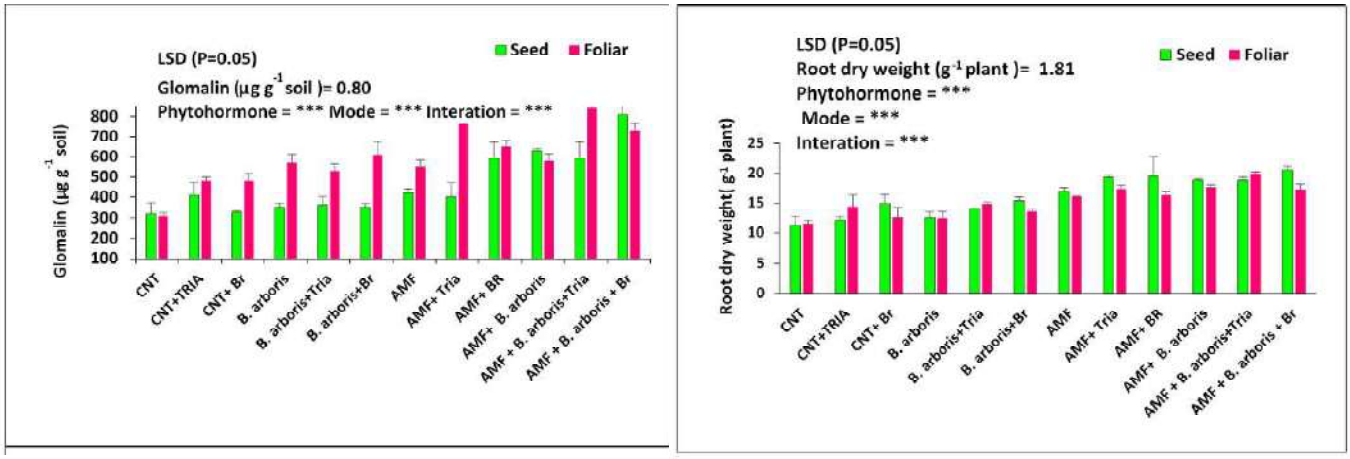


Figure 3.6.5 Integrated response of phytohormones and *B. arboris* on glomalin and root dry weight in sorghum plants grown in organic substrate amended with hulls and under unsterilized conditions. [Data are means of three replications. Vertical bars represent the standard deviation of means. LSD: least significant difference at p=0.05 for comparing the treatment means using Duncan's multiple range test].

IISR6.9/17 Bacterial mediated sulfur bioavailability in soybean

PI: Hemant S. Maheshwari, Co-PIs: M.P. Sharma, A. Ramesh, Raghavendra Nargund and Sanjeev Kumar

Coalmines located in the South-Eastern Coal Field Limited (SECL) at Bishrampur (Surajpur), Bhatgaon (Surajpur), Garepelma (IV) (Raigarh), and Jampali (Raigarh) were explored for sources of sulfur and iron bacteria. In-addition, hot water springs of Tatapani, Shankargarh and iron mines of NMDC Bailadila, Dantewada were also taken for sources of sulfur and iron bacteria. Bacteria were isolated from the soil, water, coal, mud, and agricultural soil samples. Further, isolated one chemoautotrophic and 28 heterotrophic bacteria which converts elemental sulfur into sulfate. Two multiple plant growth promoting (PGP) bacteria were isolated, which helps inphytate mineralization, phosphorus solubilization, siderophore production, and zinc solubilization. Two potassium solubilizer and seven zinc solubilizing bacteria were isolated from different habitats (Figure 3.6.6).

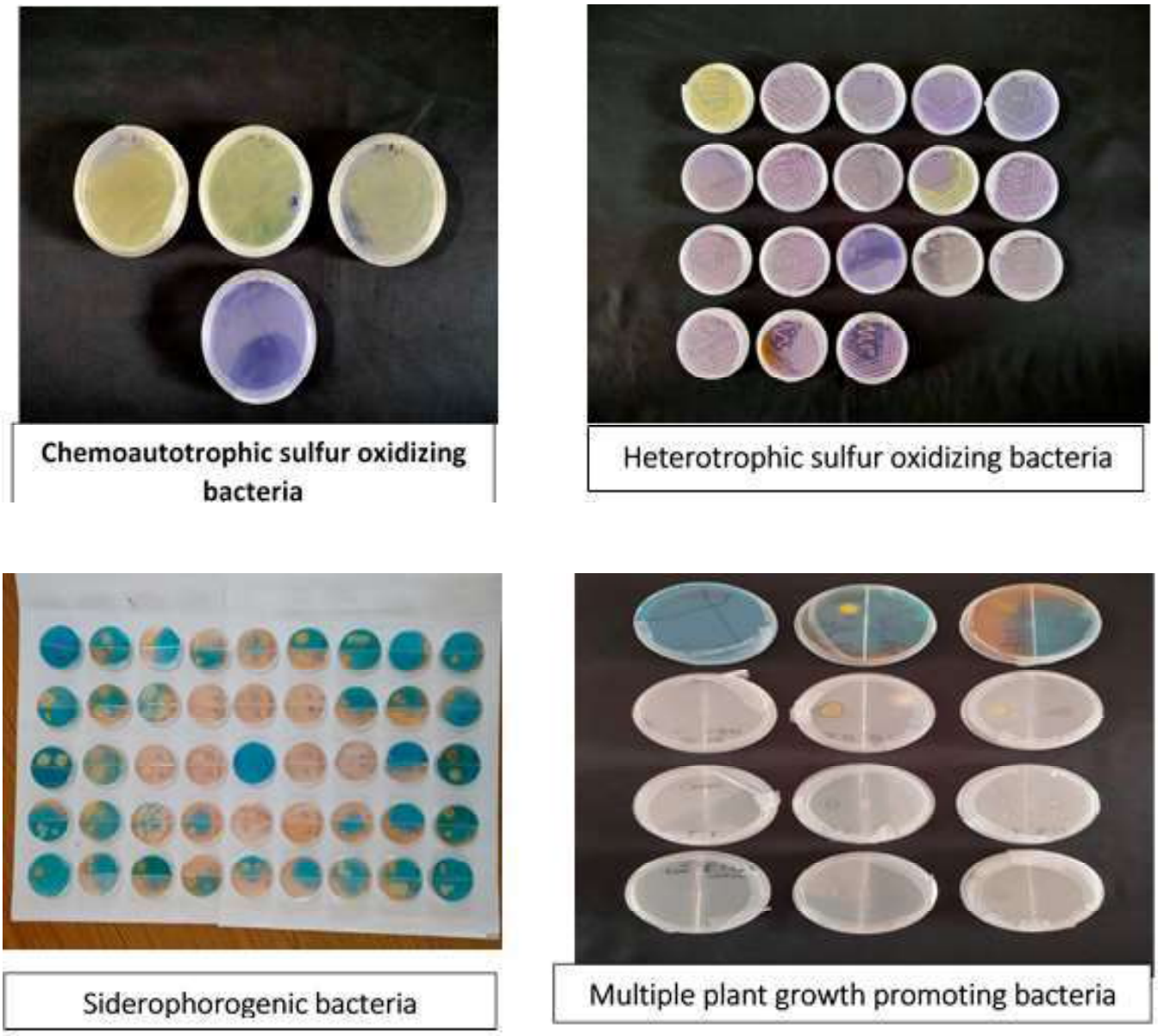


Figure 3.6.6 : Sulfur oxidizing and plant growth promoting bacteria isolated from coalmine, hot water springs and iron mines

4. Transfer of Technology

IISR8.17/20 Development and evaluation of ICT tools and media for TOT of Soybean

PI: Dupare B.U., Co-PI: Savita Kolhe

Under the ICT initiatives, the institute is making use of six social media such as YouTube Channel, Facebook Page, Instagram, Twitter, Telegram channels and WhatsApp groups for the flow of information and interaction/feedback technologies among the different stakeholders. A total of 214 videos comprising different themes has been produced and uploaded on the YouTube channel of the institute and were popularized by sharing on other social media. The playlist includes ICAR-Madhya Bharat Samachar, Weekly Soybean Advisories, Soya Samvad with Progressive Soybean Growers and Soy Scientists, Improved Soybean Varieties developed by ICAR-IISR, Indore as well as by other AICRPS centers.

Extension activities and training programmes organized

PI: Dupare B.U.

From time to time, farmers and other soybean stakeholders visit the institute for capacity building and up-gradation of technical know-how. The visits are usually a part of the ongoing schemes implemented by the agencies particularly the State Agricultural Departments, NGOs, Agricultural Extension Training Centers, Nationalized banks etc. During their visit, they were made educated about the institutional background and technologies developed and recommended for their area followed by an interaction on pertinent issues. Further, the institute has been conducting online farm seminars and other programmes during various occasions as per the instruction of ICAR headquarters. The institute has successfully conducted 43 one-day training programmes thereby updating the technical know-how of 1763 farmers including 256 women farmers who visited the institute during the year 2023 (Table 4.1). As per the request of Maharashtra state Department of Agriculture, the institute Agri-Business Incubation Centre has conducted 12 special training programmes on "Soy Food Processing Techniques and Utilization of soy for Food Products" for Farmer Producer Organizations belonging to different districts of Maharashtra through SMART project (Table 4.2). In addition, six online programmes and webinars have been organized during 2023 through which 4270 viewers have been made aware about the institutional activities, programmes and issues of national importance in addition to ways and means of soybean production and protection from insect-pests and diseases (Table 4.3).

Home pages of for six social media for ToT of Soybean

Table 4.1:One-day farmer's training programmes on improved soybean production technology

S. No	Date	District	State	Male	Female	Total
1	10.01.23	Kota	Rajasthan	40	0	40
2	09.02.23	Indore	Madhya Pradesh	35	0	35
3	10.02.23	Ujjain	Madhya Pradesh	40	0	40
4	14.02.23	Mandsaur	Madhya Pradesh	10	40	50
5	14.03.23	Kota	Rajasthan	27	0	27
6	17.3.23	Hingoli	Maharashtra	64	0	64
7	24.03.23	Yavatmal	Maharashtra	12	0	12
8	27.03.23	Beed	Maharashtra	100	0	100
9	30.03.23	CG	Chaattisgarh	50	0	50
10	30.03.23	Alirajpur	Madhya Pradesh	20	0	20
11	01.04.23	CG	Chaattisgarh	50	0	50
12	03.04.23	CG	Chaattisgarh	50	0	50
13	22.06.23	Solapur	Maharashtra	17	0	17
14	21.08.23	Ujjain	Madhya Pradesh	5	0	5
15	22.08.23	Ujjain	Madhya Pradesh	40	0	40
16	22.08.23	Sehore	Madhya Pradesh	0	36	36
17	23.08.23	Indore	Madhya Pradesh	40	0	40
18	23.09.23	Beed	Maharashtra	0	50	50
19	25.08.23	Amravati	Maharashtra	50	50	100
20	26.08.23	Harda	Madhya Pradesh	24	0	24
21	04.09.23	Yavatmal	Maharashtra	9	0	9
22	05.09.23	Vidisha	Madhya Pradesh	22	0	22
23	05.09.23	Ujjain	Madhya Pradesh	50	0	50
24	08.09.23	Indore	Madhya Pradesh	40	0	40
25	12.09.23	Hoshangabad	Madhya Pradesh	25	0	25
26	12.09.23	Indore	Madhya Pradesh	50	0	50
27	12.09.23	Khandwa	Madhya Pradesh	40	0	40
28	14.09.23	Ujjain	Madhya Pradesh	0	40	40
29	26.09.23	Ujjain	Madhya Pradesh	44	0	44
30	26.09.23	Kota	Rajasthan	33	0	33
31	26.09.23	Jhabua	Maharashtra	40	0	40
32	29.09.23	Khargone	Madhya Pradesh	35	0	35
33	04.10.23	Chhota Udaipur	Gujarat	0	40	40
34	05.10.23	Shajapur	Madhya Pradesh	40	0	40
35	09.10.23	Valsad	Gujarat	70	0	70
36	05.10.23	Rajsamand	Rajasthan	45	0	45
37	05.10.23	Bhilwarad	Rajasthan	50	0	50
38	11.10.23	Sabarkantha	Gujarat	50	0	50
39	12.10.23	Ujjain	Madhya Pradesh	50	0	50
40	15.12.23	Ujjain	Madhya Pradesh	60	0	60
41	18.12.23	Sambajinagar	Maharashtra	10	0	10
42	26.12.23	Satara	Maharashtra	10	0	10
43	27.12.23	Hingoli	Maharashtra	60	0	60
Total				1507	256	1763

Table 4.2: Three days training program on Soy Food Processing Techniques and Utilization of soy for Food Product organized by Agri. Business Incubation Center of ICAR-IISR, Indore

S. No.	Name of trainee/ institution / FPOs	Date	Numbers of participant
1	District Implementation Unit (SMART) FPO of Sangli, Maharashtra	1-3 February 2023	49
2	District Implementation Unit (SMART) FPO of Jalna, Maharashtra	13-15 March 2023	25
3	District Implementation Unit (SMART) FPO of Satara, Maharashtra	16-18 March 2023	50
4	District Implementation Unit (SMART) FPO of Parbhani, Maharashtra	24-25 March 2023	30
5	District Implementation Unit (SMART) FPO of Osmanabad, Maharashtra	27-29 March 2023	90
6	District Implementation Unit (SMART) FPO of Amravati, Maharashtra	11-13 April 2023	25
7	District Implementation Unit (SMART) FPO of Amravati, Maharashtra	10-12 October 2023	25
9	District Implementation Unit (SMART) FPO of Washim, Maharashtra	28-30 November 2023	45
10	District Implementation Unit (SMART) FPO of Yavatmal, Maharashtra	19-21 December 2023	46
11	District Implementation Unit (SMART) FPO of Parbhani, Maharashtra	27-28 December 2023	21
12	District Implementation Unit (SMART) FPO of Latur, Maharashtra	4-5 January 2024	40
Total			**486**

Table 4.3: Details of Online programmes and Seminars organized during 2023

S.No.	Title	Date	No. of participants
1	Webcast of Honble PM during Int. Millet Conf 18th March 2023	18.03.2023	520
2	Pre-kharif Online Seminar on 24th May 2023 Soybean ki kheti, unnat kismen, beej ankuran, beejopchar	24.05.2023	1200
3	Online Webinar: Awareness on Parthenium Eradocation and interaction on soy crop condition on	21.08.2023	970
4	World Soil Day on 5th Dec 2023 with Padmashri Janak McGiligan	05.12.2023	210
5	Rashtriy Kisan Diwas organized on 23rd Dec 2023. The seed of NRC 150, 181 and 165 was distributed	23.12.2023	1300
6	Awareness Programme for G20 Summit in Indore on Agriculture	09.02.2023	70
Total participants			**4270**

Table 4.4: Participation in Agricultural Exhibitions

S. No	Event	Venue	Dates
1	Malwa Kisaan Mela	College of Agriculture, Indore	24-26 May 2023
2	Agricultural Exhibition during ICVO at Hyderabad	Auditorium, PJTSAU, Hyderabad	18-20 January 2023
3	Shining Madhya Pradesh	Kalidas Academy, Ujjain	18-20 January 2023

Farmers training and input distribution under schedule caste sub-plan

Nodal officer: Rakesh Kumar Verma, Co-Nodal officers: B.U. Dupare, Prince Choyal and Raghavendra Nargund

Organized several farmers training and input distribution programmes under Schedule Caste Sub Plan (SCSP) scheme. During program, soybean seed, vegetable kit, wheat seed, NPK fertilizer, Plant Growth Promoting Rhizobacteria (PGPR), battery sprayer pump and 1 HP mono block water pump were distributed among the eligible beneficiaries. The total number of 2375 farmers from the Sehore, Khargone, Ujjain, Dewas, and Shajapur districts of the Madhya Pradesh were benefited from the scheme (Table 4.5). Similarly, trainings were also conducted for the farmers and trained them to use the new technologies, diversified crops and value addition for improving the farm productivity. Emphasis was also laid on use of climate smart technologies. Total number of 14 trainings were conducted under the SCSP scheme and a total number of 1197 farmers were benefited from the training programmes.

Table 4.5: Total number of beneficiaries under scheduled caste sub plan in year 2023-24

S. No.	Name of District	Name of inputs distributed	Number of beneficiaries under SCSP
1	Sehore and Ujjain district	Soybean seed	100
2	Sehore and Ujjain and Khargone district	Fertilizer (NPK)	450
3	Sehore, Ujjain and Khargone district	Battery Operated Power	425
4	Sehore, Khargone and Ujjain district	wheat Seed	200
5	Sehore, Khargone and Ujjain district	Vegetable Kit	343
6	Sehore, Khargone and Ujjain district	Plant growth Promoting	200
7	Sehore and Khargone district	1 Hp mono block pump	90
7	Khandwa, Sehore and Khargone district	Mung Seed	185
8	Khandwa, Sehore and Khargone district	Hand Hoe	145
9	Sehore, Khandwa, Khargone, Dewas, Shajapur and Ujjain district	Sewing Machine	162
10	Sehore, Khargone and Dewas district	Brush Cutter	40
11	Sehore, Khargone and Dewas district	Chain Saw	35
	Total Beneficiaries		**2375**

Input distribution and training under Tribe sub-plan

Inputs were distributed to the Below Poverty Level (BPL) farmers belonging to the Schedule Tribe (ST) community of Dhar, Khandwa, Barwani and Jahabua district of Madhya Pradesh. Total 125 improved battery operated spray pumps were distributed to 125 BPL farmers of ST community. Besides, 9.8 quintal of green gram (Mung) seeds, 100 vegetable seed kits and 100 bags of N.P.K. (12:32:16) fertilizer were distributed to 100 BPL farmers of ST community of Sardarpur block, district Dhar. Farmers also got trained simultaneously about various production and protection technologies of soybean, summer mung and summer vegetables, use of spray pump and other technologies.

Weekly advisory for soybean farmers

Institute also circulated weekly advisory for soybean farmers through various media platforms and email. The list of weekly advisory for soybean farmers is given below:






Glimpses of training and input distribution programme at ICAR -IISR, Indore

सोयाबीन कृषकों के लिए उपयोगी सलाह / Weekly Advisory for Soybean Farmers

1. साप्ताहिक सलाह (मई 2023 / May 2023)
2. साप्ताहिक सलाह (5-11 जून 2023/ 5-11 June 2023)
3. साप्ताहिक सलाह (12-18 जून 2023/ 12-18 June 2023)
4. साप्ताहिक सलाह (19-25 जून 2023/ 19-25 June 2023)
5. साप्ताहिक सलाह (26 जून-2 जुलाई 2023/26th June-2nd July 2023)
6. साप्ताहिक सलाह (3-9 जुलाई 2023/3rd-9th July 2023)
7. साप्ताहिक सलाह (10-16 जुलाई 2023/10th -16th July 2023)
8. साप्ताहिक सलाह (17-23 जुलाई 2023 / 17th -23rd July 2023)
9. साप्ताहिक सलाह (24-30 जुलाई 2023 / 24-30th July 2023)
10. साप्ताहिक सलाह (31 जुलाई-6 अगस्त 2023/31st July-6th August 2023)
11. साप्ताहिक सलाह (7-13 अगस्त 2023 / 7th-13th August 2023)
12. साप्ताहिक सलाह (14-20 अगस्त 2022 / 14th-20th August 2023)
13. साप्ताहिक सलाह (21-27 अगस्त 2022 / 21st-27th August 2023)
14. साप्ताहिक सलाह (28 अगस्त-3 सितम्बर 2023 / 28th August-3rd September
15. साप्ताहिक सलाह 4-10 सितम्बर 2023 / 4th-10th September 2023)
16. साप्ताहिक सलाह (11-17 सितम्बर 2023 / 11th-17th September 2023)
17. साप्ताहिक सलाह (18-24 सितम्बर 2023 / 18th-24th September 2023)
18. साप्ताहिक सलाह (25 सितम्बर -1 अक्टूबर 2023 / 25th September-1st October 2023)
19. साप्ताहिक सलाह (2-8 अक्टूबर 2023 / 2nd to 8th October 2023)
20. साप्ताहिक सलाह (9-15 अक्टूबर 2023/ 9th to15th October 2023)

5. Annual Group Meeting of AICRP on Soybean

The 53rd Annual Group Meeting of AICRP on soybean was organized at Rajmata Vijayraje Scindhia Krishi Vishwa Vidyalaya (RVSKVV), Gwalior on 16 and 17th May 2023. The inaugural session was commenced under the leadership of Dr. T.R. Sharma, DDG (Crop science), ICAR, New Delhi. The session was graced by the esteemed presence of Dr. Arvind Kumar Shukla, the Vice Chancellor of RVSKVV, Gwalior, who served as the Chief guest. Other notable attendees included Dr. Sanjeev Gupta, ADG (Oilseed and Pulses), Dr. Kunwar Harendra Singh, Director ICAR-IISR Indore, Dr. Sanjay Sharma, Organizing Secretary & Director of Research at RVSKVV, Gwalior, and Dr. Sanjay Gupta, In-charge of AICRP on Soybean. Dr. Sanjeev Gupta, in his remarks, emphasized the significance of soybean as an industrial and medicinal crop and the need for research and development to address the challenge of low productivity. Dr. K.H. Singh presented the Director's report, providing updates on the actions taken based on previous recommendations. Additionally, three publications on various aspects of soybean were released during the session. Dr. A.K. Shukla, the Vice Chancellor, highlighted the research efforts undertaken at ICAR-IISR, Indore, to enhance soybean crops in India and expressed concerns over declining productivity attributed to climate change. He stressed the importance of breeding stress-resistant and mechanical harvesting-compatible varieties, as well as increasing seed weight and seed number per pod. The session's Chairman, Dr. T.R. Sharma, DDG (Crop science), emphasized the crucial role of soybean in addressing malnutrition in India and the need to broaden the genetic base of soybean crop through pre-breeding efforts. He praised the achievements of scientists in developing new soybean varieties and urged the utilization of advanced breeding techniques to enhance soybean cultivation. Concluding the inaugural session, Dr. Sanjay Gupta, In-charge, AICRP soybean, expressed gratitude to all the participants and contributors, acknowledging their role in making the inaugural session of the Annual Group Meeting a success.

Technical sessions

The Plant Breeding and Genetic Resource session was Chaired by Dr. Sanjeev Gupta, ADG (O & P) at ICAR, New Delhi, while Dr. K.H. Singh, Director of ICAR-IISR, Indore, served as the Co-chairman. Dr. Sanjay Gupta, P.I. Plant breeding presented the results of breeding trials conducted during the *Kharif* season in 2022, including coordinated trials and evaluations of germplasm and hybridization programs. The discussion led to several recommendations, including identification of entries for next round of evaluation in co-ordinated breeding trials, testing of quarantined *G. soja* accessions for disease reactions at hot spots, screening new accessions for specific traits, identifying top-ranking genotypes for further breeding programs and finalizing crosses for National Hybridization Programme in 2023. Other topics discussed included trial rejection criteria and promotion criteria for different maturity groups and food grade categories. The technical sessions of Entomology and Pathology were Chaired and Co-chaired by Dr. R.K. Pandya, Professor of Plant Pathology and Dr. M.L. Sharma, Professor of Entomology both from RVSKVV, Gwalior, respectively. Dr. Ashwani Basandrai, Ex-Dean of CSKHPKVV, Palampur was the subject matter expert in both the sessions. Dr Lokesh Kumar Meena, P.I. Entomology presented the annual progress report on entomological experiments conducted across 11 coordinated centers in the country. Dr. Meena presented the seasonal incidence of insect pests in soybean, the effectiveness of natural bio-control agents in suppressing pest populations, identification of insect-resistant/tolerant genotypes through field and laboratory screening, and promising genotypes for insect resistance/tolerance, the evaluation of microbial consortia for managing insect pests and intercropping with Suva (*Anethum graveolens*) as a strategy to control defoliators in soybean. Dr. K.P. Singh from G.B. Pant University of Agriculture & Technology, Pantnagar presented the annual report of Plant pathology discipline. Dr. Singh shared the results of nine coordinated plant pathology experiments conducted at 14 centers, focusing on soybean diseases. Anthracnose/Pod blight, Yellow Mosaic Virus (YMV), and Rusts were identified as the most prevalent and destructive diseases. Dr. Singh discussed the use of microbial pesticides for disease management and highlighted the effectiveness of seed treatment and foliar spraying with *Bacillus* sp. EF 53 and *Trichoderma viride*. During the discussion session, suggestions were made to survey and track diseases using GPS technology, establish virus diagnosis facilities, address seed availability issues, and evaluate resistant lines under different conditions.

The Agronomy session was Chaired by Dr. Pratap Singh, Director of Research at Agriculture University, Kota. Dr. Yashvir Singh Shivay, Principal Scientist at ICAR-IARI, New Delhi, served as the expert. Dr. R.K. Verma, P.I., Agronomy, presented the results of five agronomical trials conducted during the *Kharif* season in 2022. The Microbiology session was Chaired by Dr. A.K. Saxena, former Director of ICAR-NBAIM, with Dr. Swarna Lakshmi, Principal Scientist in Microbiology at IARI, New Delhi, serving as the expert. Dr. M.P. Sharma, P.I. of Microbiology, presented the annual report of this discipline. It was suggested that a demonstration on IISR microbial consortia (*Bradyrhizobium daqingense* + *B. aryabhataii*) should be conducted in which the necessary cultures for the demonstration would be supplied by IISR, Indore. During the concluding remarks, Dr. A.K. Saxena emphasized the importance of developing more soybean

rhizobial strains and re-evaluating the status of soybean rhizobial populations in Madhya Pradesh soils.

Dr Sanjeev Gupta, ADG (O&P) and Dr R K Mathur were the Chair and Co-chair of the Transfer of Technology session. Dr S.K Jha, Principal scientist (O&P), ICAR, New Delhi, was the expert of the session. Dr. Raghavendra Nargund, the Principal Investigator presented the FLD progress and discussed the allocation of new FLDs for the year 2023. Dr. Sanjay Gupta provided updates on the TSP and NEH activities. It was suggested to involve the staff from state departments and Krishi Vigyan Kendras (KVKs) during field days and visits to FLD plots. There was a recommendation to invite industry professionals to participate in FLDs that involve food-grade technologies, particularly in the central zone. In terms of FLD allotment, only varieties less than five years old should be considered. It was also suggested to conduct impact analysis of the FLDs by revisiting previously demonstrated sites. Additionally, it was proposed to geotag all FLDs as a mandatory requirement. Dr Sanjeev Gupta, ADG (O&P) Chaired the Food Technology session and Dr Gyanesh Satpute served as the rapporteur. Dr. L. Sophia Devi, Principal Investigator presented the annual progress report. It was decided to evaluate only AVT II entries for further assessment and the food grade parameters for oil, soya milk, and tofu should be clearly specified, and these specifications would be determined through wider consultations. All of the released varieties would be profiled for Kunitz Trypsin Inhibitor (KTI) and Lipoxygenase 2 (Lox 2) levels. Tofu yield will be reported in tofu produced / Kg of soybean grain, starch and protein content would also be estimated as part of the food grade parameters. For all of the above sessions, technical programme was formulated for the year 2023.

Recommendations

Following recommendations were emerged from the 53rd Annual Group Meeting of AICRP on Soybean:

- Seven varieties viz., PS 1670 (for NPZ), RSC 2011-35 9for EZ), and JS 22-12, JS 22-16, NRC 165, NRC 181 and NRC 188 (for CZ) were recommended for the release.
- The application of thiourea as foliar spray @ 750 ppm/ha at 20 -25 and 50 -55 days after sowing is recommended across all the zones.
- Inclusion of maize in crop rotations found beneficial over continuous soybean mono-cropping.
- Since the difference between minimum and conventional tillage were found non-significant, so minimum tillage is recommended due to high B: C ratio.
- The combination of *Nomuraea rileyi* @2kg/ha and *Bacillus thuriengiensis* @1kg/ha was found most effective treatment in managing of defoliator insect-pests viz., bihar hairy caterpillar, tobacco caterpillar, semiloopers and leaf webber.

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6. Events and Meetings

Events

ICAR Central Zone sports tournament

For the first time, the "Central Zone Sports Tournament" of the Indian Council of Agricultural Research (ICAR) was organized by the institute in Indore. The tournament was organized during 3rd January 2023 to 6th January 2023 at the School of Physical Education of Devi AhilyaVishwavidyalaya, Indore. The Vice Chancellor of Devi AhilyaVishwavidyalaya, Dr. Renu Jain was the Chief guest while Dr. C.R. Mehta, Director of ICAR-Central Agricultural Engineering Institute, Bhopal was the guest of honor for this occasion. The Directors of the University and ICAR institutes added dignity to the event, in which Dr. Sudhira Chandel, Director, Physical Education, DAVV, Indore; Dr.Aniket Sanyal, Director, NISHAD, Bhopal; Dr. A.B. Singh, Director, Indian Institute of Soil Science, Bhopal; Dr. J.S. Mishra, Director, Directorate of Weed Research, Jabalpur; Dr. B.P. Bhaskar, Director, NBSS & LUP, Nagpur; Dr. Sharad Chowdhary, Dean, College of Agriculture, Indore; Dr. Deepak Mehta, Head, Physical Education, D.A.V.V.; Dr. K.C. Sharma, Head, IARI, Regional Center, Indore were present. At the outset, Dr. K.H. Singh, Director, IISR, Indore expressed his gratitude to Dr.Renu Jain, the Chief guest of the program for extending the sport infrastructure and the facilities to the players of national agricultural research institutes. In her remarks, Dr.Renu Jain said that these are some important moments of life which one should spend while playing, but victory and defeat should be adopted with sportsmanship. She added "Adopt the results with spirit, give the best contribution and try to improve every time". While announcing opening of the tournament open, she mentioned an inspirational quote "The most satisfactory life is that which is spent in the pursuit of becoming the best version of yourself ". Dr. K. H. Singh welcomed the guests and all the participants and gave an overview of the ICAR Zonal tournament. He encouraged all the participants to give their best and play every game in good spirits. The flame was brought by Dr. Rajesh Vangala, a senior athlete of the ICAR – IISR and tournament torch was lighted by the Chief guest and Guest of Honour of the function. The oath ceremony was held and all the Chief-de-Mission of the Institutes took the oath on behalf of the whole contingent. The oath was read by Dr. Giriraj Kumawat, Senior Scientist while formal vote of thanks was proposed by Dr. Gyanesh Satpute, Principal Scientist, ICAR-IISR, Indore. All the teams from 15 institutes including their Chief-de-Mission, managers and about 550 players participated in various events of the tournament.

There were 13 events for men and 06 events for women in the tournament. ICAR-IARI won 19 gold medals, 8 silver medals and 8 bronze medals. ICAR-CIAE bagged 3 gold medals, 8 silver medals and I bronze medal while ICAR-IISR won 2 gold medals, 3 silver medals and one bronze medal. Overall championship trophy was awarded to ICAR-IARI, New Delhi team.

International conference on vegetable oils 2023 (ICVO 2023)

ICAR-IISR partnered with ICAR-IIOR, Hyderabad in organizing the International conference on vegetable oils 2023 (ICVO 2023) during 17th-21st January 2023. This conference was envisaged to be a convergent point for priority persuasion and provide a platform to deliberate on research strategies, infrastructure

developmental needs, trade and value chain ecosystems, and policy perspective to promote increased vegetable oil production on short-, medium- and long-term basis at global as well as national levels. Several invited talks, plenary talks, contributory oral as well as poster presentations and technology exhibitions were demonstrated during the conference. Also, five satellite symposia dedicated to specific issues of major vegetable oil crops were also executed during the conference. Satellite symposium on soybean was organized on 20th January 2023. The session started by welcome remarks by Dr. K.H. Singh, Director, ICAR-Indian Institute of Soybean Research, (IISR), Indore. Dr. K.H. Singh further delivered his talk on overview and challenges in soybean production. He highlighted major challenges in soybean production and discussed various strategies to meet these challenges as well as soybean area expansion. He also highlighted the yield gap insoybean productivity and policy interventions required to bridge the gap.

Dr. Babu Valliyodan, Asst. Prof of Genetics and Director Genomics Program, Lincoln,University, Missouri, USA, delivered a talk on Genome-wide association studies insoybean. He highlighted development and use of various genomic resources by histeam. He also stressed on use of these resources for development of nutritionally enhanced soybean varieties, genetic diversity studies and gene discovery. Dr. Naoki Yamanaka, Senior Researcher, from Japan International Research Center for Agril. Sciences (JIRCAS), Japan, delivered a talk on Breeding for Asian soybean Rust resistance. He concluded that gene pyramiding of rust resistant genes leads to strong resistance against pathogen. Dr.Trupti Joshi, Assistant Professor and Next Gen Translational Bioinformatics lead at University of Missouri, Columbia, USA, delivered a recorded talk on Translational Genomics Tools for Soybean Improvement. She discussed recent development and use of bioinformatics and web-based tools for translational research in soybean. Dr. Madan Bhattacharyya, Professor, Department of Agronomy, Iowa State University, IA, USA, delivered a talk Towards understanding molecular basis of broad-spectrum pathogen and pest resistance encoded by the soybean protein *GmDR1*. This was followed by oral presentations by Dr. M.P.Sharma, Dr. Sanjay Gupta, Dr J. G. Manjaya, Dr.Vineet Kumar, Dr. Milind Ratnaparkhe and Dr. Mrunal Kuchlan. Speakers highlighted various technologies for increasing the production and productivity of soybean and also discussed strategies for high quality soybean seed production. Further short oral presentations were madeby 16 Speakers.

A panel discussion on 'Improving soybean production system" was moderated by Dr. Madan Bhattacharya. Panelist included Dr. Nita Khandekar, Dr Anita Rani and all the invited speakers of soybean workshop. During the deliberations, the following suggestions/ recommendations were emerged:

1. Efforts should be made for productivity enhancement by development of high yielding and climate resilient varieties. For this purpose, trait specific germplasm identification, gene discovery, marker development and their application, andgene editing are important approaches.

2. Area expansion by new target region specific cultivar development, extensionand education to new farmers, and policy initiatives like incentives to farmers in non-traditional area.

3. Educating farmers about rainwater management and better land configuration formitigating drought and waterlogging situations

4. Development of specialty soybean, value addition and popularization of soybean food products for further enhancing food uses of soybean.

5. Public and private partnership for research and capacity building including technology transfer.

The session ended by vote of thanks by Dr. Nita Khandekar. Further, ICAR-IISR bagged two best oral presentation awards, one best poster award and one best paper award during the conference.

World soil day

On 5th December 2023, institute has celebrated "world soil day". The Chief guest of the event was Padma Shri recipient, social worker and the founder-Director of Jimmy Mc Gilligan Centre For Sustainable Development, Smt. Janak Palta Mc Gilligan. On this occasion, Smt. Mc Gilligan has delivered a talk on importance of conserving the natural resources, especially soil for the future generations. She further emphasized on the role of natural and organic farming in human and soil health. Dr.Aketi Ramesh, Principal scientist, has presented the status of soil health parameters of the institute's fields. Dr. K.H Singh, Director, ICAR-IISR, urged the scientists to maintain the soil health of the research plots through various measures.

Swachta Pakhwada 2023

'Swachhta Pakhwada 2023' was celebrated from December 16-31, 2023 and various activities were conducted during the event. During the inaugural programme of Swacchta Pakhwada, all the scientific, administrative, and technical staff led by the Director of the institute Dr K.H. Singh, took oath of a clean and green India. Cleaning program has been carried out within the institute by all the staff of the institute. The programme was concluded with the prize and certificate distribution to the winners during the valedictory programme organized. Shri Shyam Kishore Verma, the Member Secretary of Swacch Bharat Abhiyaan, organized various activities meticulously.

Soybean Seed Day on the occasion of 'Rashtriya Kisan Diwas'

Soybean Seed Day was organized on the occasion of 'Rashtriya Kisan Diwas' to commemorate the birth day of Former Prime Minister Shri Choudhury Charan Singh, on 23rd December 2023 at the campus of ICAR-IISR, Indore. The programme was graced and addressed by Dr. Kunwar Harendra Singh, Director, ICAR-IISR. More than 1200 farmers form Madhya Pradesh, Rajasthan and Maharashtra participated in this programme. A total of 1300 seed packets of NRC 150, NRC 165 and NRC 181 were sold during this programme to make farmers self-sufficient for seeds of new varieties.

37th Foundation day of ICAR-IISR

The institute celebrated its 37th foundation day on December 11th, 2023. Agricultural Scientists Recruitment Board (ASRB) Chairman, Dr. Sanjay Kumar graced the occasion as the Chief guest while the former Director of the institute, Dr V.S. Bhatia was the guest of honour to the event. Institute Director Dr K. H Singh welcomed dignitaries and presented a brief report of the institute. The Chief guest,Dr. Sanjay Kumar congratulated the institute for its contribution towards betterment of soybean and farmers, and addressed about the possible research dimension in soybean. The former Director of the institute, Dr V.S. Bhatia said that in the last 37 years, the institute has developed a number of varieties with desirable traits like high yield and food grade characters which need to be promoted through the formal extension mechanisms. On this occasion, a film of the institute's journey from inception till present time was inaugurated. During the programme several institute publications were released. Acknowledging the untiring efforts of institute staff, best workers were awarded.In scientist category award was conferred to Dr Shivakumar M., while Dr.Nikhilesh Pandya and Smt.Sagar Bai were awarded in the technical and supporting staff category, respectively. Best team awards were also given to administration and finance section, and farm section for their outstanding contribution to the institute.

National Campaign

Republic day

To commemorate the day on which the Constitution of India came into effect, institute has celebrated country's 74th republic day on 26th January 2023. On this occasion, Dr. K.H Singh, Director, ICAR-IISR addressed about the importance of the constitution of India and how Indian turned from a dominion country to a republic country.

International Yoga Day

Theme for International Yoga Day 2023 was "Yoga for Vasudhaiva Kutumbakam". The institute celebrated the International Yoga Day on June 21, 2023. The day is aimed to raise awareness worldwide of the many benefits of practicing yoga. A yoga session was organized under the guidance of Dr. Monika Parmar, Head and Yoga expert, Madhavbaug clinic, who encouraged the staff to practice yoga. On this occasion, Dr. K.H Singh, Director, ICAR-IISR urged the staff to maintain physical health through practicing the yoga asanaas. Mr. Ravishankar, Assistant, coordinated the event.

Independence day

Institute has celebrated country's 77th independence day on 15th August 2023. On this occasion, Dr. K.H Singh, Director, ICAR-IISR, addressed about the importance of the day to the nation and remembered the sacrifices of the freedom fighters in getting the India free from the

colonization. He also urged the institute's staff to serve the nation through enhancing the soybean production and to make India self-sufficient in edible oil.

18th *'Parthenium hysterophorus'* awareness week

Parthenium hysterophorus is known by different names in different parts of the country. It is one of the most persistent weeds and the ill effects of which have been seen mainly in the form of reduction in crop production and diseases like eczema, asthma, and allergies etc. in humans. To get rid of the problems caused by this grass, a week-long awareness program was organized across from August 16-22, 2023. In the week-long programme, a session was organized at the institute, in which Dr Raghavendra Nargund, Scientist (Agronomy) appraised the personnel about the problems caused by *Parthenium heterophorias*. Different events like cleaning of fields, cleaning of campus etc were also held. The event was led by Shri. S.K Verma, Estate officer.

Vigilance awareness week

On the directives of Central Vigilance Commission Government of India, institute observed Vigilance Awareness Week 2023 from 30th October 2023 to 5th November 2023. All the scientific, administrative, and technical staff led by the Director of the institute, Dr K.H. Singh, took oath in this regard. Director called upon the employees to follow the office ethics, protocol, guidelines as well as the conduct rules and to work for the institute with full integrity and honesty. On 2nd November, all the staff members led by the Director, performed the walkathon within the institute. The program was concluded on 6th October with the valedictory-cum-prize distribution.

Scientific meetings

37th Institute Research Council

The meeting of the Institute Research Council (IRC) of ICAR-IISR was held on April 24-25, 2023. Chairman of IRC & Director ICAR-IISR, Dr K.H. Singh, chaired the session. The Member Secretary, Dr Manoj Srivastava presented the action taken report of 36th IRC. Principal investigators of projects presented activities and achievement of the respective project. Dr K.H. Singh appreciated the research activities going-on and emphasized the need to make plans for quick multiplication and distribution of seed of newly developed varieties. He added that emphasis should be given on incorporating stress tolerance and disease resistance in varieties and on traits like photo-thermo-insensitivity and long juvenility. Further, he urged the scientists to deliver at least one product/technology/publication from each project as outcome and at least one mega product per year at the institute level. He emphasized on the precision

of the field and lab experiments and proposed an internal monitoring committee to monitor the experiments.

26th Research Advisory Committee meeting

The 26th Research Advisory Committee (RAC) meeting was held at ICAR-IISR, Indore during 30-31st May 2023, in hybrid mode. The meeting was held under the Chairmanship of Dr S.K. Sharma, Ex-Vice Chancellor, Himachal Pradesh Krishi Vishwavidyalaya, Palampur with the members Dr Sanjeev Gupta, ADG (OP), ICAR, New Delhi, Dr. K.H Singh, Director, ICAR-IISR, Indore, Dr T.K. Adhya, Ex-Director, ICAR-NRRI, Cuttack, Dr O.P. Sharma, Ex Director, ICAR-NCIPM, New Delhi and Prof. R.S.Singhal, Ex-Dean, Food Engg & amp; Tech, ICT, Mumbai. A comprehensive report about the overall research and development activities of institute was presented by Dr K.H Singh, Director, ICAR-IISR. The Secretary of the RAC, Dr Mahaveer Prasad Sharma presented the action taken report of the recommendations of previous meeting. The Chairman and members came up with recommendations for further improvement and streamlining of the research activities. The committee members appreciated the efforts made by the institute. The committee also undertook field visit to the research farm as well as nearby village and interacted with soybean farmers.

27th Research Advisory Committee meeting

New RAC committee has been constituted under the Chairmanship of Dr. Swapan Datta, Ex-DDG (Crop Science) ICAR, New Delhi. The newly constituted RAC visited ICAR-IISR, Indore during 21-22nd, September 2023. Dr. K.H Singh, Director, ICAR-IISR, welcomed the Chairman and the members of the committee. Dr. M.B Ratnaparkhe, member secretary, has presented the action taken report of 26th RAC. Dr. Sanjay Gupta, Principal Scientist presented about the status of augmentation & management of genetic resources, breeder seed production and AICRP Soybean. Dr. Anita Rani, PrincipalScientist &Incharge, Crop Improvement Section presented the research status of soybean breeding, biotechnology, biochemistry and seed technology. Dr. B.U.Dupare, Principal Scientist & Incharge, Crop Production Section presented the research status on the soybean production technologies, while Dr. M.P. Sharma, Principal Scientist & Incharge, Crop Protection Section presented research on the soybean protection technologies. Dr. Swapan Datta, RAC Chairman appreciated the research work going-on at the institute and urg1ed the scientists to come up with the technologies towards India's self-sufficiency in oilseeds. The committee has visited the research fields of the institute and advised the scientists about the ways for the betterment of the research experiments. Further, a farmer's field visit was also carried out to interact and to know the production problems at farmer's field level.

Quinquennial Review Team (QRT)

Indian Council of Agricultural Research constituted a Quinquennial Review Team (QRT) for ICAR-IISR Indore for the period of 2017 to 2021. Dr S Rajendra Prasad, Ex Vice Chancellor, UAS, Bengaluru was the Chairman and (1) Dr. S. R. Bhat, Ex- Principal Scientist & Professor, ICAR- National Institute for Plant Biotechnology, (2) Dr. Prabhakar, Ex- Project Coordinator, AICRP on Small Millets, Bengaluru (3) Dr M A Shankar, Ex- Director of Research, UAS, Bangalore (4) Dr. O. P. Sharma, Ex- Principal Scientist (Plant Pathology) and (5) Dr. Sandeep Saran, Principal Scientist (Agricultural Economics) were the members of the team. Dr. Sanjay Gupta, Principal Scientist, ICAR-IISR Indore was the member secretary of the team. Initial meeting of the QRT was held on 21st and 22nd February, 2023 at the institute for reviewing the IISR Indore and planning the schedule of visit to AICRP centres. QRT reviewed the ICAR-IISR on the 21st January and visited soybean farmers in nearby Indore area on 22nd February. QRT visited Dharwad to review the centres of Southern Zone, Medziphema (Nagaland) for Eastern and North Eastern Hill Zone, Jabalpur for Central Zone, Pantnagar for Northern Hill Zone and Northern Plain Zones. The last meeting to summarize all visits, meet with institutional management committee and to draft the recommendations was held on 29thSeptember 2023. In this meeting, QRT visited the experimental plots and interacted with scientists.

Talks/Seminars/Field Day/Interaction meets

Talk by Prof.V.P. Vara Prasad

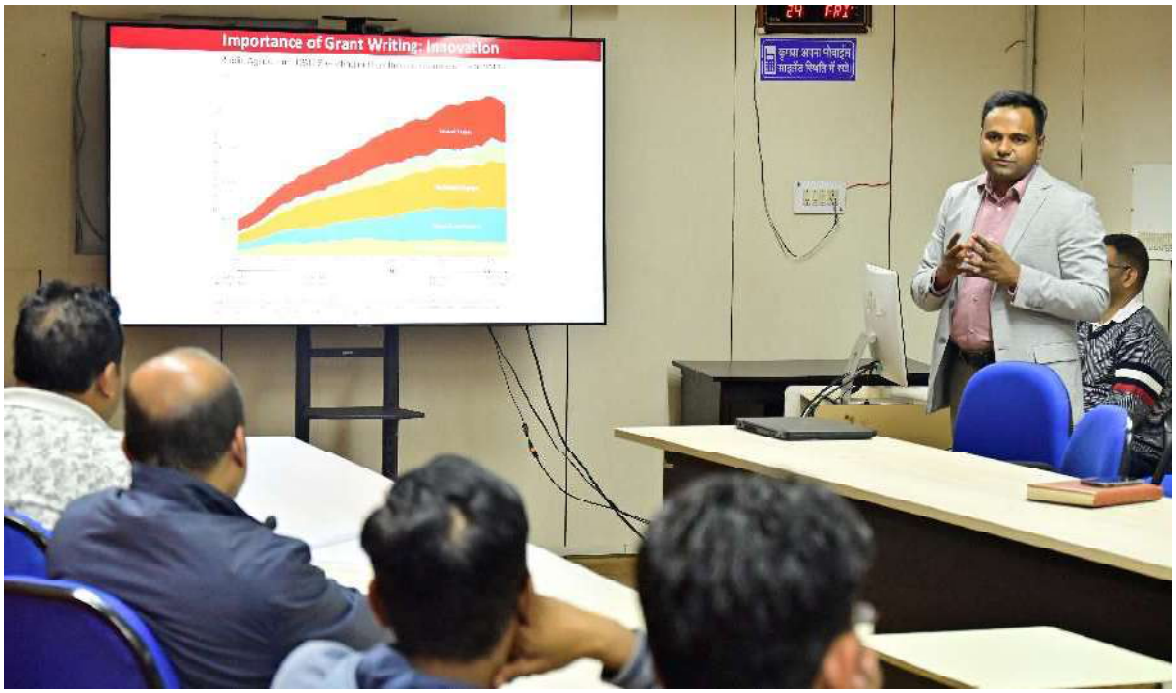
On 11th January 2023, Prof. V.P. Varaprasad,Director of the Sustainable Intensification Innovation Lab, at Kansas State University, USA delivered a lecture on "Effect of high temperature and drought in soybean" as a keynote speaker at the institute. Prof.Varaprasad is a distinguished Professor of Crop Ecophysiology. He had also worked as a President of the Crop Science Society of America. In his speech, he emphasized the research on the impact of climate studies on soybean productivity. He explained how Kansas State University is using drones to observe the crops and measure their growth. In the Indian scenario, Prof.Varaprasad said that due to the timely availability of seeds, farmers get enough time for seed treatment, in which the adoption of best production technologies acts as a driving force. On this occasion, the director of the institute, Dr. K.H. Singh honoured the guest speaker Prof.Varaprasad with a bouquet and a memento for his experienced exhortation.

Scientist interaction meet and talk by Dr. Naoki Yamanaka

Dr. Naoki Yamanaka, Senior Researcher from Japan International Research Centre for Agriculture Sciences (JIRCAS), Tsukuba, Japan visited the Institute on 13th Jan., 2023. A scientist interaction meet was organized at ICAR-IISR, Indore, in which Dr. Naoki Yamanaka presented his work on Asian Soybean rust research work carried out in South America. This was followed by discussion and question answers section. Possibility of collaboration with JIRCAS on Asian soybean rust research was discussed. Director Dr. K. H. Singh, appreciated Dr.Yamanaka's work and requested him to collaborate with scientists in India for development of durable rust resistant varieties using gene pyramided lines developed by him. Later Dr. Yamanaka visited Molecular breeding and Plant pathology labs, and the germplasm growing in glass houses. *Rpp* gene pyramided lines of soybean developed by JIRCAS were imported by IISR for collaborative research. Later he also visited AICRPS centers of UAS, Bangalore and UAS, Dharwad for collaboration.

Talk by Dr. Prakash Kumar Jha

Dr. Prakash Kumar Jha, an Assistant Professor at Mississippi State University delivered a talk on key strategies on writing collaborative grants on 15th December 2023. He also discussed climate resilient initiatives by his lab Mississippi Agroclimatology Lab (MACLab). He engaged with scholars on crop modeling, remote sensing and climate forecast based decision support systems for better management strategies under climate variability. He explained the key strategies of writing effective grants. He shared that writing effective grants is an art that requires a blend of research, storytelling, and financial planning.



Demonstration of drone technology

On 10th March 2023, the institute successfully conducted demonstration on use of drone for conducting the necessary plant protection measures. Director, Dr K. H. Singh on this occasion congratulated the scientists, staff and other stakeholders associated with soybean and hoped that this will help to manage the biotic factors causing yield losses in soybean.

Monitoring of field experiments during *Kharif* season

A committee comprising of Director, ICAR-IISR, Dr. K. H. Singh, Incharge, Crop improvement Dr. Anita Rani, Incharge, Crop production Dr. B. U. Dupare, Incharge, Crop Protection Dr. Mahaveer Sharma and Incharge, PME Dr. Punam Kuchlan, monitored field experiments during 8th – 10th August, 2023.Committee interacted with all scientists at their field experiment site and suggested measures for improvement. Objective of this internal monitoring was to enhance interaction among scientists and increase the precision in research experiments.

Distinguished Visitors

Shri. Manoj Ahuja, Secretory, Department of Agriculture and Farmers Welfare, New Delhi, visited on 27 Jan., 2023

Dr. Mangala Rai, Ex-Director General, ICAR, New Delhi, visited institute on 04th August, 2023

Dr. A.K Singh, Director, ICAR-Indian gricultural Research Institute, New Delhi, visited institute on 13th March, 2023 and 04th August, 2023

Dr. J.K. Jena, DDG (Fisheries), ICAR New Delhi, visited institute on 15th September 2023

7. Ongoing Research Projects

Project No.	Years	Project Title	PI/CC-PI
CROP IMPROVEMENT			
Mega theme- Soybean genetic resource management- Acquisition, conservation, characterization, documentation and utilization			
NRCS 1.1/87	1987-LT	Augmentation, management and documentation of soybean germplasm	Dr. Sanjay Gupta
Mega theme- Genetic improvement of soybean for yield, agronomic traits, resistance to biotic stresses and improvement in quality of soybean seed			
IISR 1.33/16	2016-LT	Development of YMV resistant soybean varieties using marker assisted selection	Dr. Anita Rani
IISR 4.3/23	2023-2028	Enhancement of seed longevity of vegetable soybean (*Glycine max* L. .Merr.) genotypes	Dr. Punam Kuchlan
IISR 4.4/23	2023-2031	Breeding for high grain and oil yield for different maturity duration in soybean	Dr. Shivakumar M
IISR 4.5/23	2023-2031	Soybean breeding for resistance against charcoal rot and anthracnose diseases	Dr. Nataraj V.
IISR 3.12/19	2019-2024	Soybean Improvement against defoliating insects	Dr. Vangala Rajesh
IISR 4.6/23	2023-LT	Pre-breeding for broadening of genetic base in soybean	Dr. Vangala Rajesh
Mega theme- Managing the impact of current and future climate variability in soybean			
DSR 5.6a/08	2009-LT	Breeding for drought resistance / tolerance varieties in soybean	Dr. Gyanesh K. Satpute
IISR 7.8/23	2023-2028	Trait identification and physiological breeding for water logging tolerance in soybean	Dr. Prince Choyal
ISSR 3.16/21	2021-2026	Identification of genes/loci for better root system in soybean	Dr. Giriraj Kumawat
Mega theme- Development of specialty soybean varieties for secondary agriculture and industrial uses			
NRCS 1.12/02	2002-LT	Breeding for food grade characters and high oil content	Dr. Anita Rani
IISR 3.15/2020	2020-2024	Development of genome edited soybean lines with improved oil quality	Dr. Milind B. Ratnaparkhe
CROP PROTECTION			
Mega theme- Surveillance, forecasting and control strategies for insect pest complex in soybean			
IISR 6.10/22	2022-2027	Soybean Improvement against Rhizoctonia aerial blight disease	Dr. Sanjeev Kumar
IISR 3.13/21	2021-2024	Isolation and identification of kairomones and sex pheromones components for soybean stem fly, *Melanoagromyza sojae* management	Dr. Lokesh Kumar Meena
CROP PRODUCTION			
Mega theme- Development of technologies for soybean based cropping system efficiency enhancement through resource conservation technologies, nutrient management. plant growth promoting microbes			
IISR 3.12/2020	2020-2024	Interaction effect of phytohormones and AMF for enhanced nodulation, growth, yield of soybean with improved AMF symbiosis in the rhizosphere	Dr M. P. Sharma
IISR 6.9/17	2017-2020	Bacterial mediated sulphur bioavailability in soybean	Sh. Hemant Maheshwari

IISR 6.10/23	2023-2028	Standardization of sustainable (Natural / Organic farming / Conservation agriculture) management practices for soybean yield maximization under soybean based cropping systems	Dr. Raghavendra M
IISR 4.13/17	2022-2027	Evaluation of residue management practices under permanent broad bed furrow as well as conventional tillage practices for sustaining/ improving resource use efficiency, soil quality and crop productivity in soybean-based cropping systems	Dr. Rakesh Kumar Verma
EXTENSION			
Mega theme- Information digitization, technology dissemination, impact analysis and socio-economic research for soybean			
DSR 7.7/23	2023-2025	Development of Seed and Product Sale Portal for Online marketing in Soybean	Dr. Savita Kolhe
IISR 8.17/20	2020-2025	Development and evaluation of ICT tools and medias for TOT of Soybean	Dr. B. U. Dupare
IISR 8.18/23	2023-2033	Use and effectiveness of various extension programme for TOT of soybean	Dr. B. U. Dupare

EXTERNAL FUNDED PROJECTS

DAC, Government of India	2005-LT	DUS testing of soybean-Central sector scheme for protection of plant varieties and farmers right.	Dr. Mrinal K. Kuchlan
ICAR	2006-LT	ICAR – Seed Project: Seed Production in Agricultural Crops.	Dr. Mrinal K. Kuchlan
DAC, Minister of Agriculture	2018-2023	Creation of Seed Hubs for enhancing quality seeds availability of major oil seed crops under NFSM-Oil Seeds	Dr. Mrinal K. Kuchlan
SERB, DST Govt. Of India	2022-2025	Genomics strategies for improving anthracnose resistance in soybean (*Glycine max* L.)	Dr. Milind B. Ratnaparkhe
DBT, Government of India	2022-2025	Expansion of Activities of Biotech-KISAN Hub in Eight Aspirational Districts in Madhya Pradesh – Phase II	Dr. Rakesh Kumar Verma
SERB, DST, Govt. Of India	2021-2024	Genome- wide ass ociation mapping of charcoal rot resistance in soybean (*Glycine max* L.)	Dr. Nataraj V.
BRNS, BARC, Mumbai	2022-2025	Development of high oleic acid mutants of KTi and lox2 free soybean gamma and electron beam	Dr. Vineet Kumar
DBT Government of India	2021-2024	Developing food-grade soybean using CRISPR/Cas9 mediated multiplex genome editing	Dr. Vineet Kumar
NASF, ICAR	2022-2025	Marker assisted stacking of yellow mosaic disease resistance, null Kunitz trypsin inhibitor, null lipoxygenase-2 genes, and broadening the genetic base of soybean	Dr. Vineet Kumar
DBT Government of India	2022-2025	Marker assisted introgression of seed weight, early maturity and photoperiod response genes in multiple stress tolerant climate smart soybean variety JS97-52 and KTI free variety NRC 127	Dr. Shivakumar M.
NASF, ICAR	2023-2026	Targeted improvement of stress tolerance, nutritional quality and yield of crops by using genome editing	Dr. Anita Rani

*** LT: Long Term**

8. Publications, Patents, Awards and Recognition

Publications

1. Amrate, P.K., Srivastava, M., Bhale, M.S., Agrawal, N., Kumawat, G., Shivakumar M. and Nataraj, V.(2023). Identification and molecular characterization of high-yielding charcoal rot resistant soybean genotypes in India. Scientific Reports. https://doi.org/10.1038/s41598-023-35688-2

2. Bais, D.S., Tiwari, V., Kolhe, S. and Jain, S. (2023). IoT and AI enabled framework to monitor soil and crop health for sustainable development in precision farming-A Study. Biological Forum.15(2):742-749.

3. Bharti, A., Maheshwari, H.S., Garg, S., Anwar, K., Pareek, A., Satpute, G.K., Prakash, A. and Sharma, M.P. (2023). Exploring potential soybean *Bradyrhizobia* from high trehalose-accumulating soybean genotypes for improved symbiotic effectiveness in soybean. International Microbiology. 26(4):1-15. doi:10.1007/s10123-023-00351-3.

4. Bhartiya, A., Rajesh, V.,Aditya,J.P., Jeevan B.,Gupta, S., Kant, L.,Joshi, H.,Mehtre, S.P.,Devi,H.N., Jaybhay,S., Karnwal,M.K., Nataraj, V. and Khandekar, N. (2023). Evaluation of indigenous and exotic soybean accessions for yield, resistance to frog-eye leaf spot and yellow mosaic virus diseases. Plant Genetic Resources: Characterization and Utilization. 1-7. doi:10.1017/S1479262123000941.

5. Chandra, S., Kumawat, G., Satpute, G.K., Bhatia, V.S., (2023) Evaluation of soybean genotypes for high temperature tolerance during reproductive stages. Journal of Oilseed Research: 40 (Special issue): 90-91.

6. Chandra, S., Ratnaparkhe, M.B., Satpute, G.K., Gupta, S., Kumawat G., et al. (2023) Genome wide association studies reveals genetic loci associated with water logging tolerance in Soybean [*Glycine max* (L.) Merr.]. Journal of Oilseed Research, 40 (Special issue): 36-37.

7. Chauhan, J., Singh, P., Choyal, P., Mishra, U.N., Saha, D., Kumar, R., Anuragi, H., Pandey, S., Bose, B., Mehta, B. and Dey, P. (2023). Plant photosynthesis under abiotic stresses: damages, adaptive, and signaling mechanisms. Plant Stress. https://doi.org/10.1016/j.stress.2023.100296

8. Dupare, B.U. and Kolhe, S. (2023). Effectiveness of social media for the dissemination of soybean production technologies. Soybean Research 21(1): 87-97.

9. Dupare, B.U. and Kolhe, S. (2023). ICT and social media digital initiatives for effective dissemination of Soybean technologies. Journal of Oilseeds Research, 40 (Special Issue): 17-18.

10. Dwivedi, R., Tiwari, A., Bharill, N., Ratnaparkhe, M.B. (2023) A novel feature extraction technique for the clustering of SNP data. Journal of Oilseed Research. 40 (Special issue):222-223.

11. Jaiswal, S., Bhatt, J., Rajput, L., Maheshwari, H.S., Vennampally, N., Kumar, S., Pandey, V. and Sharma, M.P. (2023). Soybean Bacterial Endophytes *Bacillus subtilis* (EB-1) and *Bacillus amyloliquefaciens* (EB-2) against anthracnose survival in leaf and soil. Biological Forum-An International Journal. 15(10): 1305-1309.

12. Jaiswal, S., Rajput, L., Bhatt, J., Maheshwari, H.S., Kumar, S., Sharma, M.P., Vennampally, N., Pandey, V., Shivakumar, M., Sharma, R. and Behera, K. (2023). Soybean bacterial endophytes against anthracnose disease collected from Karnataka State: An *in-vitro* study. International Journal of Environment and Climate Change. 13 (11):1835-1845. DOI: 10.9734/IJECC/2023/v13i113341.

13. Jha, P., Tiwari, A., Bharill, N., Ratnaparkhe, M.B., Patel, O.P. et al. (2023). Machine learning algorithm for soybean leaf disease detection. Journal of Oilseeds Research, 40 (Special issue): 170-171.

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15. Jumrani, K., Bhatia, V.S., Kataria, S. et al. (2023) The interactive effect of high temperature and water deficit stress on nitrogen fixation, photosynthesis, chlorophyll fluorescence, seed yield and quality in soybean (*Glycine max*). Plant Physiol. Rep. https://doi.org/10.1007/s40502-023-00763-3

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17. Koraboyana, V., Gill, B.S., Sirari, A., Khosla, G., Bindra, S. and Kumar, V. (2023). Parent genome contribution and its relationship with grain yield in backcross-derived lines of soybean (*Glycine max*). Plant Breeding. 142(2): 140–148. https://doi.org/10.1111/pbr.13073

18. Kuchlan, M.K., Kuchlan, P., Srivastava, M. (2023) Improvement in seed germination potential and adaptability of vegetable soybean (*Glycine max*Merr.). Journal of Oilseed Research, 40 (Special issue):408-409.

19. Kuchlan, P. and Kuchlan, M.K. (2023). Effect of Salicylic Acid on Plant Physiological and Yield Traits of Soybean. Legume Research- An International Journal. 46 (1): 56-61.

20. Kumar, S., Rajput, L.S., Nataraj, V., Shivakumar, M., Maheshwari, H.S., Nargund, R., Kumawat, G., Jaiswal, S., Singh, J.K., Kesharwani, A.K. and Yadav, M.K. (2023). First report of milkweed (*Euphorbia geniculata*) as an alternative host for *Colletotrichum truncatum* in soybean fields in India. Plant Disease. 107(12), p.4025.

21. Kumawat, G., Shivakumar, M., Shrivastava, H., Yadav, A., Nataraj, V., Chandra, S., Rajesh, V., Satpute, G.K., Ratnaparkhe, M. and Gupta, S. (2023). A consistent 100-seed weight QTL with pleiotropy for seed number/plant in soybean (*Glycine max* L.). Journal of Oilseeds Research. 40 (Special Issue):25-26.

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24. Mahobiya, C., Kolhe, S. and Iyer, S. (2023). Hybrid Features based Classification of Insect and Leaf Disease of Soybean Plants using Random Forest Classifier. International Journal of Engineering Trends and Technology. 71(2): 408-420.

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38. Sharma, M.P., Bharti, A., Chourasiya, D., et al. (2023) Exploring microbial symbionts for improving soybean production and soil carbon sequestration. Journal of Oilseed Research, 40 (Special issue):465-466.

39. Sreenivasa, V., Babu, P.K., Sooganna, D., Chandra, S., Nargund, R., Amaresh., Lal, S.K. (2023). Standardization of new screening method and evaluation of soybean (*Glycine max* (L.) Merrill) genotypes for seedling stage drought tolerance under *in-vitro* conditions. Agriculture Mechanization in Asia. 54(8): 15061-15076.

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Books and book chapters

1. Chourasiya, D., Buade, R., Gajghate, R., Bharti, A., Prakash, A., Gupta, M. and Sharma, M.P. (2023). Revisiting the Biodiversity and Ecosystem Functioning of ArbuscularMycorrhizal Fungi Under Different Agricultural Management Practices and Environmental Stresses In: Applied Mycology for Agriculture and Foods (Eds. SK Singh et al., 1st Edition) CRC press (Taylor Francis); Pages 53-78. Doi : 10.1201/9781003369868-4

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Popular articles

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पद्धतियाँ. किसान की गाथा. भोपाल 1–31 जुलाई 2023. पृष्ठ क्रमांक 12.

3. सलोनी मंडलोई, वी. नटराज , बी.यु. दुपारे, संजीव कुमार, शिवकुमार, एम् एवं राजकुमार रामटेके. 2023. सोयाबीन की खेती में ग्रीष्मकालीन गहरी जुताई का महत्त्व. किसान की गाथा. भोपाल 1–30 अप्रैल 2023. पृष्ठ क्रमांक 13
4. सलोनी मंडलोई, वी. नटराज , शिवकुमार, एम, एवं बी.यु. दुपारे, 2023. सोयाबीन की चारकोल सडन बीमारी के लक्षण एवं नियंत्रण के उपाय. किसान की गाथा. भोपाल 1–31 जनवरी 2023. पृष्ठ क्रमांक 5.

Technical/Extension bulletins/Folders

- Dupare B.U., Verma, R.K., Nargund, R., Meena, L.K., Kumar, S., Kuchalan, M. and Singh, K.H. (2024). Modern Methods of soybean production and Technical recommendations. Extension Bulletin No. 19. ICAR-Indian Institute of Soybean Research, Publication. Pp 74.
- Kuchlan, P. Kuchlan, M. K. and Khan. I. R. (2023). Edited Raajbhsha Patrika Soyvritika Beej Visheshank vol (2) ICAR-Indian Institute of Soybean research Indore, MP, India Pp 83.
- Kuchlan, M.K. and Kuchlan, P. (2023). Compendium of DUS characteristics of soybean extant varieties, ICAR-Indian Institute of Soybean research Indore, and India. Pp 86.
- दुपारे, बी.यु. 2023. अधिक उत्पादन एवं कम खर्च की खेती हेतु सोयाबीन फसल में क्या नहीं करें? विस्तार फोल्डर 24 (2024)
- दुपारे, बी.यु. 2023. अधिक उत्पादन हेतु सोयाबीन फसल में क्या, क्यों, कब और कैसे करें? विस्तार फोल्डर 25 (2024)
- दुपारे, बी.यू., राकेश कुमार वर्मा, राघवेन्द्र नर्गुंद, लोकेश मीना, संजीव कुमार, मृणाल कुचलन एवं के. एच. सिंह. 2024. सोयाबीन की आधुनिक खेती: तकनिकी अनुशंसाएं. तकनिकी बुलेटिन क्रमांक 19. भा.कृ.अनु.प. भारतीय सोयाबीन अनुसन्धान संस्थान प्रकाशन, इंदौर पृष्ठ– 74
- दुपारे, बी.यू., राकेश कुमार वर्मा, लोकेश मीना, संजीव कुमार, मृणाल कुचलन एवं के.एच.सिंह. 2023 सोया कृषकों के लिए साप्ताहिक सलाह (खरीफ 2023). तकनिकी बुलेटिन 2023(4) भा.कृ.अनु.प. – भारतीय सोयाबीन अनुसंधान संस्थान प्रकाशन. पृष्ठ 84
- नेहा पांडेय, एम.पी. शर्मा, अभिषेक भारती, योगेश सोहनी (2023) सोयाबीन प्रंस्करण, मूल्य संवर्धन व उपोत्पाद उपयोगी विभिन्न तकनिकी बुलेटिन, पृष्ठ 26, भा. कृ. अनु. प.– भा. सो. अनु. सं., इंदौर.

Conference presentations / exhibitions attended

- Kumawat, G., Maranna, S., Shrivastava, H., Yadav, A., Nataraj, V., Chandra, S., Rajesh, V., Satpute, S.K., Ratnaparkhe, M. and Gupta, S. (2023). A consistent 100-seed weight QTL with pleiotropy for seed number per plant in soybean (*Glycine max* L.) In book of abstracts, International Conference on Vegetable Oils, ICAR-IIOR, Hyderabad, January 17-21, 2023.
- Kuchlan, M.K.,Kuchlan P and Srivastava M (2023) Improvement in seed germination potential and adaptability of vegetable soybean (Glycine Max L. Merr.). Presented during international Conference in Vegetable Oils (ICVO 2023): Research, Trade, Value Chain and Policy, organized by ICAR-Indian Institute of Oilseeds Research, Hyderabad from Jan 17-21, 2023.J. Oilseed Research 39 (Special Issue) : 408-409
- Kolhe, S., Saxena, A. and Dupare, B.U. (2023). Development of seed and product sale portal for digital marketing. In Proceedings of International Conference on, "Pulses: Smart Crops for Agricultural Sustainability and Nutritional Security", Feb. 10-12, 2023 at NASC, New Delhi-110012, pp 376.

- Dr Savita Kolhe presented paper "A Novel Approach for Detection of Soybean Leaf Disease using Bayesian Optimized-KNN Classifier with NCA based Feature Selection" in 3rd International Conference on Emerging Trends and Technologies on Intelligent Systems (ETTIS-2023) organized by Organization Name: CDAC in association with the Petroleum-Gas University of Ploiesti, Romania and the University of Haute-Alsace, France, 23-24 Feb 2023.

- Dr Savita Kolhe presented paper "ICT and social media digital initiatives for effective dissemination of soybean technologies" in International Conference on Vegetable Oils 2023 (ICVO 2023) organized by Indian Society for Oilseeds Research, ICAR-IIOR, Hyderabad, 17-21 Jan 2023.

- Dr Savita Kolhe presented poster "Development of seed and product sale portal for digital marketing", in International Conference on Pulses: Smart crops for agricultural sustainability and nutritional security, Feb. 10-12, 2023 at NASC, New Delhi.

- Sharma MP, Bharti A, Chourasiya D, Agnihotri R, Maheshwari HS and A Ramesh (2023). Exploring microbial symbionts for improving soybean production and soil carbon sequestration. Presented during International Conference in Vegetable Oils (ICVO 2023): Research, Trade, Value Chain and Policy, organized by ICAR-Indian Institute of Oilseeds Research, Hyderabad from Jan 17-21, 2023.

- Sharma MP (2023) Biofertilizer Application in Soybean Production, CO_2 Mitigation and Business Opportunities in Agriculture Sector. Presented during Multidisciplinary International Congress "Sanmantrana" organized on "Industry 5.0 and Paradigm Shift: Emerging Challenges in association with St. Cloud State University, Minnesota, U.S.A at Shri VaishnavVidyapecthVishwavidyalaya, Indore from 1-3, February, 2023.

- Dr B. U. Dupare participated participated in MalwaKisaanMela organized at College of agriculture, Indore on 24-26 May 2023.

- Dr B. U. Dupare participated in Agricultural Exhibition during ICVO at PJTSAU, Hyderabad on 18-20 January 2023.

- Dr B. U. Dupare attended Shining Madhya Pradesh held at Kalidas Academy, Ujjain on 18-20 January 2023.

- Gyanesh Kumar Satpute, NishthaShesh, Milind B Ratnaparpkhe, Sanjay Gupta, Giriraj Kumawat, Viraj G. Kambley, Subhash Chandra, Prince Choyal and Rakesh Kumar Verma (2023). Phenotyping Root System: Dynamics of below ground architecture for productivity of soybean under low soil moisture. In Abstr. World Soybean Research Conference 11 (WSRC 11): Soybean Research for Sustainable Development (Eds. Vollmann, J., Vasiljević, M., Rittler, L., Miladinović, J., & Murphy-Bokern, D.) 18-23 June 2023, Vienna, Austria Paper No. 462 pp. 217 https://doi.org/10.5281/zenodo.7974681

- Dupare, B.U. and Sharma P. 2023. Perception of soybean growers about the impact of climate change on soybean yield in Madhya Pradesh. Proceedings of National Seminar. Souvenir & Abstracts of National Seminar on Climate Smart Agriculture for Enhancing Farmers' Livelihood and Food Security-Agricultural Extension Strategies and Apporaches. Oranized by Maharashtra Society of Extension Education at Dr. Balasaheb Sawant Konkan KrishiVidyapeeth, Dapoli during May 7-8, 2023. PP-108.

- Dr. Kunwar Harendra Singh, Director, attended and presented a talk in International Conference on Vegetable Oils 2023 (ICVO 2023) on 'Research, Trade, Value Chain and Policy' organized by IIOR, Hyderabad during 17-21, January, 2023
- Dr. Kunwar Harendra Singh, Director, attended G20 side event on Agriculture organized by Dept. of Agriculture, M.P. Govt. at Indore on 13 Feb., 2023
- Dr. Kunwar Harendra Singh, Director, participated as Chief Guest in one day meeting of producers, Farmers and officials on Seed Production organized by NSC, Indore on 02nd March, 2023.
- Dr. Kunwar Harendra Singh, Director, attended Directors Conference and ICAR-Industry Meet at NASC, New Delhi during 04 -06 March, 2023.
- Dr. Kunwar Harendra Singh, Director, attended 94th AGM of ICAR Society by Virtual mode on 10.03.2023.
- Dr. Kunwar Harendra Singh, Director, attended 90th Meeting of CSC on CSN&RV related notification of Varieties via Dy. Commissioner (QC) GOI, Seed Division, Ministry of Agril. On 02.05.2023.
- Dr. Kunwar Harendra Singh, Director, attended the Interaction session on "Potential utilization of microbes in oilseed and pulses: Strengthening and streamlining the microbiology discipline in AICRP oilseed & pulses" at IISR Indore on 10.05.2023.
- Dr. Kunwar Harendra Singh, Director, attended the XXXXXth meeting of Plant Germplasm Registration committee in virtual mode on 22.05.2023 and 12.06.2023.
- Dr. Kunwar Harendra Singh, Director, attended the 9th International Soya Food Conference at Brilliant Convention Centre Indore M.P. during 22-23 June, 2023.
- Dr. Kunwar Harendra Singh, Director, Attended the XXVII ICAR Regional Committee No.VII meeting at CIAE, Bhopal on 18.08.2023.
- Dr. Kunwar Harendra Singh, Director, attended and made a presentation on latest development in soybean breeding, in International SOYA CONCLAVE 2023 at SOPA, Indore during 07-08, Oct., 2023.
- Dr. Kunwar Harendra Singh, Director, participated as a panel member for one day workshop on "Nurturing sustainability in agricultural startups" under CRDT IIT Indore at Kalidas Seminar Hall IIT Indore on 27.10.2023
- Dr. Kunwar Harendra Singh, Director, attended the National Symposium on "R&D" Strategies for substainable production of pulse, oilseeds and millets for food security in central India" from Nov. 19-21, 2023 at RLBCAU, Jhansi, UP
- Dr. Kunwar Harendra Singh, Director, attended XXVI MEETING OF ICAR REGIONAL COMMITTEE – III, through Virtual mode/ Webcasting from ICAR, Krishi Bhavan, New Delhi Organized by: ICAR-ICAR Research Complex for NEH Region, Umiam on 01.12.2023.

रेडियो टॉक/दूरदर्शन पर प्रसारण/ फिल्म निर्माण

- डॉ बी.यु. दुपारे द्वारा सोयाबीन उत्पादन तकनिकी के प्रचार प्रसार हेतु विधियाँ. दिनांक 14 अगस्त 2023 को आकाशवाणी इंदौर द्वारा खेती गृहस्थी कार्यक्रम में प्रसारित.
- डॉ बी.यु. दुपारे का प्रगतिशील सोया कृषक श्री योगेन्द्र पंवार के साथ सोया संवाद. दिनांक 11 अप्रैल को इंदौर आकाशवाणी से खेती गृहस्थी कार्यक्रम में प्रसारित.
- डॉ बी.यु. दुपारे का डॉ विनीत कुमार एवं प्रगतिशील सोया कृषक श्री धर्मेन्द्र यादव के साथ ''सोयाबीन किस्में 7 और 138 में क्या समानता हैं'' विषय पर सोया संवाद. दिनांक 12 अप्रैल को इंदौर आकाशवाणी से खेती गृहस्थी कार्यक्रम में प्रसारित.

- डॉ. बी. यु. दुपारे. विषय–सोयाबीन में कीट एवं रोग नियंत्रण. दूरदर्शन किसान चैनल पर दिनांक 20 सितम्बर 2023 को सजीव प्रसारण.
- डॉ. बी. यु. दुपारे. विषय–सोयाबीन की उन्नत किस्में और बुअई. दूरदर्शन किसान चैनल पर दिनांक 14 जून 2023 को सजीव प्रसारण.
- डॉ. बी. यु. दुपारे (संकल्पना, स्क्रिप्ट लेखन, संकलन एवं निर्देशन) पोषण एवं खाद्य तेल में आत्मनिर्भरता हेतु समर्पित : भारतीय सोयाबीन अनुसन्धान संस्थान. दिनांक 10 दिसम्बर 2023 को संस्थान के 37वें स्थापना दिवस समारोह के अवसर पर कृषि वैज्ञानिक चयन मंडल के अध्यक्ष डॉ संजय कुमार द्वारा विमोचित.

Invited talk

1. Dr. Milind Ratnaparkhe attended World Soybean Research Conference, 18-23 June, 2023 Austria, and delivered talk titled "GWAS analysis reveal key loci associated with drought and water logging tolerance and root trait architecture in soybean".
2. Dr. Milind Ratnaparkhe attended International Conference on Vegetable Oilseeds (ICVO-23), Hyderabad during 17-21 January, 2023 and presented talk on Genomic strategies for abiotic stress tolerance in soybean.
3. Dr. Savita Kolhe presented Invited Lead Lecture entitiled "FMS-A Remote Crop Monitoring System" in National Workshop on "SmartIF-Smart Management of Agricultural Resources for Transforming Indian Farms" held at ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram during 15-17 December, 2022.
4. Sharma MP, Bharti A, Chourasiya D, Agnihotri R, Maheshwari HS and A Ramesh (2023). Exploring microbial symbionts for improving soybean production and soil carbon sequestration. Presented during international Conference in Vegetable Oils (ICVO 2023): Research, Trade, Value Chain and Policy, organized by ICAR-Indian Institute of Oilseeds Research, Hyderabad from Jan 17-21, 2023.
5. Sharma MP (2023) Biofertilizer Application in Soybean Production, CO_2 Mitigation and Business Opportunities in Agriculture Sector. Presented during Multidisciplinary International Congress "Sanmantrana" organized on "Industry 5.0 and Paradigm Shift: Emerging Challenges in association with St. Cloud State University, Minnesota, U.S.A at Shri Vaishnav Vidyapecth Vishwavidyalaya, Indore from 1-3, February, 2023.
6. Sharma MP (2023). Exploitation of microbial symbionts for sustainable soybean production. Presentation made during a web-shop on "Technological Interventions for the Vegetable Oil Sector" organized by ICAR-Directorate of rapeseed-mustard research, Bharatpur (Sponsored by MANAGE, Hyderabad) from Dec 5-8, 2023.

Patent published

Ordinary patent

1. Dr. Savita Kolhe: Title of the Invention-Integrating Machine Learning Techniques Along Wireless Sensor Network for Precise Agriculture. Patent Application No. 202341012834A. Date of Publication 17/03/2023. Patent Office Journal No 11/2023 dated 17/03/2023 (Sixth Author)
2. Dr. Savita Kolhe: Title of Invention- IOT Based Humidity Monitoring System Using Machine Learning Approach in Agriculture Field, Patent Application No 202341001498 A, Date of Publication 13/01/2023.

Awards/Peer recognitions/Member of expert panel/Journal editorial board

1) Shivakumar, M., Kumawat, G., Nataraj, V.,Gill, B.S., Madar, R. and Gupta, S (2023), Best oral presentation award for "Genetic enhancement for grain yield and mungbean yellow mosaic India virus (MYMIV) resistance through introgressions from *Glycine soja*."at ICVO 2023, Hyderabad during 17-21, January 2023.
2) Chandra, S., Kumawat, G., Satpute, G.K., Bhatia,V.S., et al. (2023)Best poster presentation

award for "Evaluation of soybean genotypes for high temperature tolerance during reproductive stages" at ICVO 2023, Hyderabad during 17-21, January 2023.

3) Dr M. Shivakumar, Best Scientist Award for the year 2022-2023 by ICAR-Indian Institute of Soybean Research, Indore.

4) The exhibition stall of the institute received Second Prize during Shining Madhya Pradesh event organized at Ujjain during 18-20 January 2023.

5) The institute exhibition stall also received Second Prize during the agricultural exhibition organized by ICAR-IIOR, Hyderabad during 17-21, January on the occasion of ICVO 2023.

6) Two progressive farmers nominated by the institute MrMeharban Singh Chaudhary and Shri Vijayendra Chauhan have been awarded during the International Conference on Vegetable Oil organized at Hyderabad during 17-21, January 2023.

7) Dr. B.U. Dupare received best research paper award during the ICVO 2023 for his research paper published during 2022 in Indian Journal of Extension Education.

8) Dr. Savita Kohte : Appreciation letter for felicitation on World Intellectual Property Day on 26th April 2023 for outstanding contribution made in acquiring copyrights, ITMU, ICAR-IISR, Indore.

9) Dr. G.K. Satpute, Principal Scientist, was awarded International travel Grant by DST-SERB as International Travel Support (ITS) to participate in WSRC11, 18-23 June 2023, Vienna, Austria.

10) Dr. G.K.Satpute received Life Time Achievement Award at WSRC11, Vienna on behalf of the Late Dr. Philip Verghees, Retd. Principal Scientist, AICRPS, ARI Pune.

11) Dr. M.P. Sharma: National Scientific Advisory Board of the Long-term farming systems comparison (Sys Com) project hosted by FiBL, Frick, Switzerland at Bio Re India, Kasrawad, Khargone, MP, India (Nov 2020 onwards).

12) Dr. Giriraj Kumawat, Member of Special Committee for reviewing the project DBT-UDSC partnership center on Genetic manipulation of Brassica- Phase II.

13) Dr. M.P. Sharma: Guest Editor, Agriculture-MDPI journal on the role of AM fungi for crop growth.

14) Dr. M.B. Ratnaparkhe: Member Advisory Board, World Soybean Research Conference, 18-23 June, 2023, Austria.

15) Dr. M.B. Ratnaparkhe,Editorial board member in BMC Genomics, Frontier in Genetics and Soybean Research.

16) Dr. M.P. Sharma: Associate Editor in Frontiers in Microbiology: Section Microbial Symbioses (Sept 2021 onwards).

17) Dr. M.P. Sharma: Associate Editor, European Journal of Soil Science (Nov 2021 onwards).

18) Dr. M.P. Sharma: Guest Editor in Frontiers in Agronomy: Soil-plant interactions for a special volume on Managing native AM fungi microbiome through crop and soil management practices in agro-ecosystems (other co-editors are from Spain, China, Switzerland, India).

19) Dr. G.K. Satpute, review editor of Frontiers in Plant Science- Plant abiotic stress.

Best oral presentation award to Dr. Shivakumar M. at ICVO 2023, Hyderabad during 17-21st , January, 2023

Continuing Committee during World Soybean Research Conference 11 (WSRC11) 18-23, June 2023, Vienna, Austria: Dr. G.K. Satpute was selected as a member of the Continuing Committee for REGION III - Central Asia

9. Linkages and Collaborations

Effective linkages and collaborations were made with the following International, National and Regional institutions/organizations for soybean research and development and extension activities:

International

Asian Vegetable Research and Development Centre, Taiwan

Japan International Research Centre for Agricultural Sciences, Tsukuba, Japan

International Crop Research Institute for Semi-Arid Tropics, Hyderabad

Borlaug Institute for South Asia (BISA), Jabalpur, India

International Center for Agricultural Research in the Dry Areas, Amlaha, India

National

SAUs in the States of Madhya Pradesh, Chhatisgarh, Maharashtra, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Rajasthan, Punjab, Haryana, Jharkhand, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, North-Eastern States.

ICAR-National Bureau of Plant Genetic Resources, New Delhi

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad

ICAR-Indian Institute of Pulses Research, Kanpur

ICAR-Central Institute of Agricultural Engineering, Bhopal

ICAR-National Research Centre for Plant Biotechnology, New Delhi

ICAR-Indian Institute of Oilseed Research, Hyderabad

ICAR-Indian Agricultural Research Institute, New Delhi and RS, Indore

ICAR-Indian Institute of Horticultural Research, Bangalore

ICAR-National Academy of Agricultural Research Management, Hyderabad

ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur

ICAR-National Institute of Abiotic Stress Management, Baramati, Maharashtra

ICAR-Directorate of Groundnut Research, Junagadh, Gujarat

National Bank for Agriculture and Rural Development

National Fertilizer Limited

Agharkar Research Institute, Pune

Indian Institute of Technology, Indore

Regional

Department of Agriculture of Madhya Pradesh, Chhattisgarh, Maharashtra, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Rajasthan, Punjab, Haryana, Jharkhand, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, North-Eastern States

NGOs like SOPA, OILFED

State Seed Corporation

Department of Seed Certification

MOU with IIT, Indore

10. राजभाषा कार्यान्वयन

संस्थान में 2023 के दौरान राजभाषा कार्यान्वयन सम्बन्धी विभिन्न गतिविधियाँ

भारतीय संविधान में हिन्दी को संघ की राजभाषा के रूप में स्थापित किया गया है एवं संविधान के भाग सत्रह, अनुच्छेद तीन सौ इक्यावन में वर्णित है की राजभाषा हिन्दी को इस तरह से विकसित किया जाय ताकि वह भारत की विविध संस्कृति को व्यक्त करने में समर्थवान हो । अतः राजभाषा के रूप में हिन्दी की भूमिका अत्यंत महत्वपूर्ण तथा दायित्व युक्त है। इस उद्देश्य का वहन करते हुये भा.कृ. अनु. प. भारतीय सोयाबीन अनुसन्धान संस्थान, इंदौर में राजभाषा हिन्दी के प्रचार–प्रसार हेतु अनेकानेक कार्यक्रम किये जा रहे है। जो राजभाषा के प्रगामी प्रयोग में अत्यंत सार्थक सिद्ध हो रहे है। इस क्षेत्र में किये जा रहे क्रिया कलापों का संक्षिप्त विवरण निम्नवत है:

राजभाषा नियम 1976 के नियम का अनुपालन : संस्थान के अधिकारी एवं कर्मचारी शासकीय कार्यों हेतु राजभाषा नियम 1976 के उपनियम (1) तथा (4) के अनुसार लिखे जाने वाली टिप्पणियों एवं अन्य कार्य हिन्दी में करते हैं।

राजभाषा कार्यान्वयन समिति की तिमाही बैठक :

प्रथम बैठक: 07 अप्रैल, 2023

द्वितीय बैठक: 06 जुलाई, 2023

तृतीय बैठक : 11 अक्टूबर, 2023

हिन्दी कार्यशालाएं: संस्थान के अधिकारियों एवं कर्मचारियों की हिन्दी में कार्य करने के दौरान होने वाली समस्यायों के निराकरण हेतु संस्थान में हिन्दी कार्यशालाओं का आयोजन किया जाता है। इसके अतिरिक्त कार्यशालाओं के आयोजन का मुख्य ध्येय यह भी होता है कि हिन्दी का प्रयोग किस प्रकार सरल से सरलतम की ओर बढाया जा सकता है। इस उद्देश्य हेतु सम्बंधित विषयानुसार कार्यशालाएं संपन्न की जाती हैं। 2023 में अब तक 04 कार्यशालाओं का आयोजन किया गया, जिसकी सूची इस प्रकार से है :

दिनांक	विषय	अतिथि वक्ता
21 अप्रैल, 2023	विश्व पटल पर हिंदी का प्रयोग एवं स्वीकार्यता	श्री राजेश श्रीवास्तव भारतीय प्रबंधन संस्थान इंदौर
31 अगस्त, 2023	हिंदी के द्वारा ही पुरे भारत को एक सूत्र में पिरोया जा सकता है	श्री संतोष मोहंती सेवा निवृत प्रबंधक बैंक ऑफ़ बड़ोदा एवं साहित्यकार, इंदौर
14 सितम्बर, 2023	राजभाषा नीतियों का क्रियान्वयन	डॉ लक्ष्मण शिंदे, विभागाध्यक्ष शिक्षा, अध्ययन शाला देवी अहिल्या विश्वविद्यालय, इंदौर
04 दिसम्बर, 2023	हिंदी भाषा के विकास में आगे क्या पहल होनी चाहिए	डॉ. श्याम सुन्दर पलोड़, विभागाध्यक्ष एवं प्रशासक, संस्कार कॉलेज ऑफ़ प्रोफेशनल स्टडीज धार रोड, इंदौर

● **प्रशिक्षण:** संस्थान में राजभाषा के प्रचार–प्रसार हेतु कृषकों एवं प्रशिक्षणार्थियों को प्रशिक्षण सम्बन्धित सारी सामग्रियां हिन्दी में प्रदान की जा रही है ।

राजभाषा अधिनियम, 1963 की धारा (3)3: संस्थान में राजभाषा अधिनियम, 1963 की धारा (3) से सम्बंधित दस्तावेजों जैसे सामान्य आदेश अधिसूचनाएं प्रेस विज्ञप्ति, संविदा, लाइसेंस परमिट टेंडर के फार्म और नोटिस संकल्प नियम इत्यादि को (हिन्दी और अंग्रेजी) द्विभाषी रूप में निकाला जाता है, ताकि राजभाषा सम्बंधित दिशा–निर्देशों का पालन सतत होता रहे।

● **यूनिकोड की सुविधा:** संस्थान के अधिकारियों तथा कर्मचारी की हिन्दी में कार्य करने की रूचि में वृद्धि करने हेतु समस्त कम्पुटर में हिन्दी यूनिकोड की व्यवस्था प्रदान की गई है जिससे एक सामान फॉण्ट के माध्यम से पूरा संस्थान एक ही दिशा की ओर अग्रसित हो सके ।

● **परिषद् मुख्यालय राजभाषा समिति का निरीक्षण:** राजभाषा समिति ने भारतीय सोयाबीन अनुसंधान संस्थान में हो रहे हिंदी में कार्यो का निरिक्षण दिनांक 27.04.2023 को किया । इस दौरान समिति ने विभाग के वरिष्ठ अधिकारीयों की उपस्थिति में हिंदी के कार्यों का अवलोकन किया। इस निरिक्षण बैठक में संस्थान की ओर से प्रभारी राजभाषा एवं श्री प्रधान वैज्ञानिक डॉ. पुनम कुचलान, प्रशासनिक अधिकारी श्री सौरभ मीना, श्री अजय श्रीवास्तव कुमार, रवि शंकर एवं आई. आर. खान ने भाग लिया।

● **राजभाषा पत्रिका सोयवृतिका के चतुर्थ अंक बीज विशेषांक का प्रकाशन:** भारतीय सोयाबीन अनुसंधान संस्थान प्रति वर्ष कृषि एवं अन्य विषयों से सम्बंधित आलेख राजभाषा पत्रिका सोयवृतिका में प्रकाशित करता है। वर्ष 2023 सोयवृतिका के चतुर्थ अंक बीज विशेषांक के द्वितीय संस्करण में विभिन्न फसलों जैसे गेंहू चना, मटर सरसों, अलसी कुसुम एवं श्री अन्न आदि के बीज उत्पादन की वैज्ञानिक तकनिकी से सम्बंधित आलेख प्रस्तुत किये गए ।

राजभाषा पत्रिका सोयवृतिका के चतुर्थ अंक बीज विशेषांक का प्रकाशन

संयुक्त क्षेत्रीय राजभाषा सम्मलेन में संस्थान को राजभाषा में उत्तम कार्य करने हेतु भारत सरकार के गृह मंत्रालय के राजभाषा विभाग द्वारा प्रथम पुरस्कार प्रदान किया गया

हिन्दी पखवाड़ा

भा.कृ.अनु.प. भारतीय सोयाबीन अनुसंधान संस्थान, इन्दौर में हिन्दी पखवाड़ा का आयोजन दिनांक 14–29 सितंबर, 2023 में किया गया । हिंदी पखवाडा कार्यक्रम का उद्घाटन संस्थान के निदेशक महोदय डॉ. कुँवर हरेन्द्र सिंह ने किया। समारोह में विशिष्ठ अतिथि के रूप में डॉ. लक्ष्मण शिंदे, विभागाध्यक्ष, शिक्षा अध्ययनशाळा, देवी अहिल्या विश्व विद्यालय इंदौर को आमंत्रित किया गया। हिन्दी पखवाड़ा के माध्यम से यह प्रयास रहा है कि संस्थान के वैज्ञानिकों, अधिकारियों एवं कर्मचारियों की रूचि हिन्दी में काम करने के प्रति निरंतर बढ़ती रहे तथा राजभाषा हिन्दी का प्रगामी विकास और प्रचार–प्रसार निरंतर होता रहे। हिन्दी पखवाड़ा के दौरान विभिन्न प्रतियोगिता का आयोजन किया गया, जो निम्नवत है–:

● दिनांक 15 सितंबर, 2023 को संस्थान के कुशल सहायक ग्रेड के कर्मचारियों हेतु हिन्दी में 'श्रुतिलेखन– प्रतियोगिता' का आयोजन किया गया, जिसके निर्णायक श्री संजय पाण्डेय एवं श्री आई आर. खान ने किया।

● दिनांक 18 सितंबर, 2023 को संस्थान के समस्त कार्मिकों हेतु प्रोत्साहन योजना के आवेदन का मूल्यांकन किया गया, जिसके निर्णायक समिति के सदस्य डॉ. महावीर शर्मा, डॉ. बी.यू. दुपारे, डॉ. ज्ञानेश सातपुते, डॉ. पुनम कुचलान, सौरभ मीणा थे।

● दिनांक 20 सितंबर, 2023 को मौलिक हिंदी स्लोगन प्रतियोगिता (विषय: ''श्रीअन्न'') का आयोजन किया गया इस प्रतियोगिता के निर्णायक डॉ. संजय गुप्ता एवं श्याम किशोर वर्मा थे ।

● दिनांक 21 सितंबर, 2023 को संस्थान के समस्त कर्मचारियों के लिए टिप्पण लेखन प्रतियोगिता का आयोजन किया गया । इस प्रतियोगिता के निर्णायक श्री संजय पाण्डेय, तकनिकी अधिकारी एवं श्रीमती प्रियंका सावन, सहायक प्रशासनिक अधिकारी थे ।

● दिनांक 22 सितम्बर, 2023 को संस्थान के समस्त कर्मचारियों के लिए हिन्दी में निबंध लेखन प्रतियोगिता विषय: ''हिन्दी – पारंपरिक ज्ञान से कृत्रिम बुद्धिमत्ता तक'' का आयोजन किया गया । इस प्रतियोगिता के निर्णायक डॉ. विनीत कुमार एवं डॉ. सविता कोल्हे, प्रधान वैज्ञानिक थे ।

● दिनांक 25 सितम्बर, 2023 को संस्थान के समस्त कर्मचारियों हेतु प्रस्तुतीकरण कुशलता सोयाबीन के व्यंजन विधि के विषय पर प्रस्तुतीकरण प्रतियोगिता का आयोजन किया गया । इस प्रतियोगिता के निर्णायक एवं डॉ. सविता कोल्हे, प्रधान वैज्ञानिक एवं डॉ. पुनम कुचलान, प्रधान वैज्ञानिक थे ।

● दिनांक 27 सितम्बर, 2023 को संस्थान के समस्त कर्मचारियों हेतु प्रश्न मंच– प्रतियोगिता का आयोजन किया गया । समस्त प्रतियोगिताओं में कर्मचारियों ने बढ़–चढ़कर अपनी सहभागिता का प्रदर्शन किया तथा प्रतियोगिता के माध्यम से अधिकारियों एवं कर्मचारियों में हिन्दी के प्रति और अधिक कार्य करने का उत्साह और प्रेरणा जागृत हुई। इस प्रतियोगिता का संचालन डॉ पुनम कुचलान प्रधान, वैज्ञानिक एवं प्रभारी अधिकारी राजभाषा ने किया ।

● दिनांक 29 सितम्बर, 2023 को हिंदी पखवाड़ा कार्यक्रम का समापन एवं पुरस्कार वितरण समारोह संपन्न हुआ,जिसमे सभी पात्र प्रतिभागियों को पुरस्कार देकर सम्मानित किया गया तथा इस कार्यक्रम के सफल संचालन एवं समापन पर संस्थान के निदेशक डॉ. कुँवर हरेन्द्र सिंह द्वारा सभी प्रतिभागियों को बधाई एवं शुभकामनाओं के साथ हिंदी में अधिक से अधिक कार्य करने का अनुरोध किया गया । पुरस्कार वितरण एवं समापन समारोह कार्यक्रम का संचालन श्री श्याम किशोर वर्मा द्वारा किया गया ।

हिंदी पखवाडा 2023 की झलक

संस्थान के निदेशक डॉ कुँवर हरेन्द्र सिंह की अध्यक्षता में हिन्दी पखवाड़ा 2023 कार्यक्रम का शुभारंभ

विशिष्ट अतिथि डॉ. लक्षमण शिंदे, प्रोफ़ेसर संस्थान के अधिकारियों एवं कर्मचारियों को संबोधित करते हुए

हिन्दी पखवाड़ा – 2023 का पुरस्कार वितरण एवं समापन समारोह कार्यक्रम में निदेशक महोदय विजताओं को पुरस्कार देते हुए

11. Important committees

Institute Management Committee

Rule	Name	Designation
66(a)1	The Director, ICAR-IISR, Indore	Chairman
66(a)2	Shri M. Selvendran, Commissioner & Director, Department of Agriculture, Bhopal (M. P.)	Member
66(a)3	Shri Bhima ram Commissioner & Director, Office of commissioner of Agriculture, Jaipur	Member
66(a)4	Vice Chancellar, Director Extension Services RVSKVV, Gwalior (M.P.) Nominated Dr Y. P. Singh, Director Extension Services	Members
66(a)5	Sh. Rajkumar Patel, Village Suatlai, Jabalpur (M.P.) Sh Chanbasappa(Ajit), Baburao Nadagadalli, Kolhapur, Maharashtra.	Member
66(a)6	Dr O.P. Premi, Principal Scientist, ICAR-IISWCR, Chandigarh	Member
	Dr Naveen Singh, Principal Scientist, Division of Genetics, ICAR-IARI, New Delhi	Member
	Dr S. K. Jha, Principal Scientist (Oilseeds and pulses), Crop Science division, ICAR,	Member
	Dr Yashvir Singh Shivay, Principal Scientist, Agronomy Division of Agronomy, ICAR-IARI, New Delhi.	Member
	Dr K. C. Sharma, Principal Scientist, ICAR-IARI regional Station New Delhi.	Member
66(a)7	The Assistant Director General (O&P) Krishi Bhawan, ICAR, New Delhi	Member
66(a)8	Sh. M. K. Mulani, Senior Finance and Accounts Officer, ICAR-IISS, Nabibagh, Berasia Road, Bhopal (M.P.)	Member
66(a)9	Senior Administrative Officer, ICAR-IISR, Indore	Member-Secretary

Research Advisory Committee (*w. e. f.*07.06.2020 to 06.06.2023)

Chairman	Dr S.K. Sharma, Former Vice Chancellor, CSK H.P. Krishi Vishwavidyalaya, Shanti Kunj, Ghuggar Tanda, Palampur-176062
Member	Dr T.K. Adhya, Former Director, ICAR-NRRI, Cuttack and Professor, School of Biotechnology, KIIT University, Bhubaneswar) Bhubaneswar (Odisha) 751 009
Member	Dr K.R. Koundal, Former Jt. Director (Research), ICAR-IARI & Director, ICAR-NIPB, New Delhi
Member	Dr P.G. Karmakar, Former Director, ICAR-CRIJAF, Barrackpore, Kolkata West Bengal-743136
Member	Dr Rekha S. Singhal, Professor of Food Technology, Former Head, Food Engineering Mumbai - 400 019 (M.S.)
Member	Dr K. H. Singh, Director, ICAR-Indian Institute of Soybean Research, Khandwa Road Indore 452001 (M.P.)
Member	Dr Sanjeev Gupta, ADG. (Oil Seeds & Pulses), ICAR, Krishi Bhawan, New Delhi-110001
Member	Shri Bansilal Gurjar, Village Lal Ghati, Post Sabakhada, Distt. Mandsaur (M.P.)
Member Secretary	Dr M.P. Sharma, Principal Scientist (Microbiology) ICAR-Indian Institute of Soybean Research, Khandwa Road, Indore-452001

Research Advisory Committee (*w. e. f.* 07.06.2023)

Chairman	Dr. S. K. Datta, Former DDG (CS), ICAR & Former VC, Visva-Bharti, University, Santiniketan, West Bengal
Member	Dr. S. R. Bhat, Retired Principal Scientist & Professor, ICAR-National Institute for Plant Biotechnology, New Delhi
Member	Dr. Masood Ali, Former Director Indian Institute of Pulse Research (ICAR-IIPR), Kanpur, UP
Member	Dr. V. K. Baranwal, National Professor (Virology), Division of Plant Pathology, IARI, New Delhi
Member	Dr. Ashutosh Upadhyay, Professor, Department of Food Science & Technology, NIFTM Industrial Estate, Kundli, Sonipat, Haryana
Member	Dr. K. H. Singh, Director, ICAR-Indian Institute of Soybean Research, Indore 452001 (M.P.)
Member	Dr. Sanjeev Gupta, ADG. (Oil Seeds & Pulses), ICAR, Krishi Bhawan, New Delhi
Member Secretary	Dr. Milind Ratnaparkhe, Principal Scientist ICAR-Indian Institute of Soybean Research, Khandwa Road, Indore

Other Committees of Institute

1.	**Official Language Implementation Committee** Ex-officio Director, ICAR-IISR (Chairman) Dr Punam Kuchlan Dr S.K. Pandey Dr D.N. Baraskar Shri Ravi Shanker Kumar Sr. Administrative Officer Sr. Finance & Accounts Officer	2.	**Institute Technology Management Committee (ITMC)** Director, ICAR-IISR (Chairman) Dr K. C. Sharma, IARI RS, Indore Dr Anita Rani Dr Milind Ratnaparkhe Dr M. K. Kuchlan Dr Punam Kuchlan, I/c PME Dr M.P. Sharma, Member secretary (I/c ITMU)
3.	**Priority Setting Monitoring and Evaluation (PME) Cell** Dr Punam Kuchlan (Chairman) Dr Shivakumar M. Dr. Raghvendra Nargund Dr. Giriraj Kumawat (Member Secretary)	4.	**Purchase Advisory Committee (PAC)** Dr Savita Kolhe (Chairman) Dr. A Ramesh Dr G K Satpute Dr Rakesh Kumar Verma Dr. V. Nataraj Sr. Administrative Officer Sr. Finance & Accounts Officer
5.	**Human Resource Development Committee** Dr Milind Ratnaparkhe (Chairman) Dr. Shivakumar M. Dr Giriraj Kumawat Dr S. K. Pandey Ms. Avinash Kalanke Sr. Administrative Officer	6.	**Consultancy Processing Cell (CPC)** Dr M.P. Sharma (Chairman) Dr Mrinal Kuchlan Dr Lokesh Meena Dr Raghvendra Nargund Sr. Finance & Accts. Officer Sr. Administrative Officer
7.	**Student Affairs Committee and Higher Study Committee** Dr Sanjay Gupta (Chairman) Dr Vangala Rajesh Mrs. Jyoti meena	8.	**Technology Transfer and Extension Activities Committee** Dr Dr B.U. Dupare (Chairman) Dr Sanjay Gupta Dr M. P. Sharma Nodal officer MGMG Nodal officer NEH Dr. Lokesh Meena (Nodal officer TSP) Dr Rakesh Kumar Verma (Nodal officer SCSP) Sr Administrative Officer Sr Finance& Accounts Officer
9.	**Estate and Guest House Management Committee** Shri S. P. Singh Shri R.N. Shrivastava Sh. R.C. Sakya Sh. O.P.Vishwakarma Ms. Jyoti Meena Ms. Seema Chauhan Sr. Administrative Officer	10.	**Publication Committee (Annual Report)** Dr. Giriraj Kumawat (Chairman) Dr A. Ramesh Dr V Nataraj Dr Vangala Rajesh Dr Raghavendra Nargund Dr. Sanjeev Kumar

11.	**Library Advisory Committee** Dr. Anita Rani (Chairman) Shri Ram Manohar Patel Dr. V. Nataraj Shri R. N. Singh Sr. Finance & Accounts Officer Sr Administrative Officer	12.	**Foreign Deputation and Higher Study Committee** Dr. Milind B. Ratnaparkhe (Chairman) Dr. Savita Kolhe Representative from PME Sr Administrative Officer
13.	**Works Committee** Dr. G. K. Satpute (Chairman) Dr. Raghvendra Nargund (Co-Chairman) Dr. Vangala Rajesh Sh R. N. Singh Sr. Administrative Officer Sr. Finance & Accounts Officer Estate Officer	14.	**Agriculture Knowledge Management Unit** Dr. Savita Kolhe (Chairman) Dr. B.U. Dupare Dr. Avinash Kalanke
15.	**Women Complaint Committee on Sexual Harassment** Dr. Punam Kuchlan (Chairman) Ms. Priyanka Sawan Ms Seema Chauhan Third Party Representative (To be nominated as & when required) Administrative Officer	16.	**House Allotment Committee** Dr. Gyanesh K. Satpute (Chairman) Dr. Giriraj Kumawat Dr. Rakesh Kumar Verma Estate officer SFAO Sr. Administrative Officer (Member Secretary) Mrs Priyanka Sawan , IJSC memeber
17.	**Centralized Public Grievance Cell and Monitoring Systems (CPGCMS)** Dr. Vineet Kumar	18.	**Store Management Committee** Dr. Nikhlesh Pandya Mr I. R. Khan Ms. Seema Chauhan
19.	**Liaison Officer (SC/ST/OBC)** Dr. Punam Kuchlan (SC/ST) Dr. Savita Kohle (OBC)	20.	**Security Cell** Shri S. P. Singh (Chairman) Shri O.P. Vishwakarma Shri R. C. Shakya
21.	**Farm Management , Price Fixation , Farm item Disposal Committee** Dr. M.K. Kuchlan (Chairman) Dr. Rakesh Kumar Verma Sh R C Saakya Store Officer S Finance & Accts. Officer S Administrative Officer	22.	**Sport and Staff Welfare Committee** Dr. Shiva Kumar M. Sh. R. N. Shrivastava Sh. S. P. Singh Shri. R. C. Shakya Ms. Seema Chauhan Sh. Sanjeev Mishra Sh. Balbir Singh SAO SFAO

23.	**Swachh Bharat Abhiyaan Committee** SAO Sh. R.N.Shrivastava Dr. D.N. Baraskar Shri S.K. Verma Mrs. Jyoti Meena Shri I.R.Khan Shri R. C. Shakaya Shri. Anil Crasco SFAO Sh. Surla	**24.**	**Institute Publication /Printing, Press & Media Committee (General)** Dr, B.U. Dupare (Chairman) Dr, Savita Kohle Dr, Lokesh Meena Dr, D.N. Baraskar Shri S.K. Verma
25.	**Vehicle Management Committee** Dr. G. K. Satpute (Chairman) Dr, Lokesh Meena Dr, Sanjay Pandey	**26.**	**Physical Verification and Condemnation Committee** Dr. G. K. Satpute (Chairman) Dr Savita Kohle Dr. Rajesh Vangala Dr. S. K. Pandey Shri R. N. Shrivastava Shri I R Khan Shri Balbir Singh Store Officer SFAO Shri Ajay Kumar Shrivastava, AAO (Member Secretary)
27.	**Tender Committee** Dr, M. B. Ratnaparkhe (Chairman) Dr, Prince Choyal Shri Hemant Maheshwari		

12. Personnel

S. No.	Name	Designation
Director and Scientific staff		
1.	Dr Kunwar Harendra Singh	Director
2.	Dr Nita Khandekar	Pri. Scientist (till 28.03.2023)
3.	Dr Sanjay Gupta	Pri. Scientist
4.	Dr Anita Rani	Pri. Scientist
5.	Dr Mahaveer P. Sharma	Pri. Scientist
6.	Dr Vineet Kumar	Pri. Scientist
7.	Dr A. Ramesh	Pri. Scientist
8.	Dr Buddheswar U. Dupare	Pri. Scientist
9.	Dr Savita Kolhe	Pri. Scientist
10.	Dr R. Ramteke	Pri. Scientist (till 23.03.2023)
11.	Dr Manoj K. Srivastava	Pri. Scientist (till 19.06.2023)
12.	Dr Punam Kuchlan	Pri. Scientist
13.	Dr M.B. Ratnaparkhe	Pri. Scientist
14.	Dr Gyanesh K. Satpute	Pri. Scientist
15.	Dr Mrinal K. Kuchlan	Sr. Scientist
16.	Dr Giriraj Kumawat	Sr. Scientist
17.	Dr M. Shivakumar	Sr. Scientist
18.	Mr. Ram Manohar Patel	Sr. Scientist (On study leave)
19.	Ms. Neha Pandey	Scientist SS (On study leave)
20.	Dr V. Nataraj	Scientist SS
21.	Dr Rajesh Vangala	Scientist SS
22.	Dr Raghavendra Nargund	Scientist SS
23.	Dr Lokesh Kumar Meena	Scientist SS
24.	Dr Rakesh Kumar Verma	Scientist SS
25.	Dr Prince Choyal	Scientist
26.	Mr. Sanjeev Kumar	Scientist
27.	Mr. Hemant Maheshwari	Scientist
28.	Mr. Viraj Kamble	Scientist (On study leave)

Administrative Staff		
29.	Mr. Saurabh Meena	SAO
30.	Mr Somnath Mukharjee	AFAO
31.	Mr. Ajay Shrivastava	AAO
32.	Ms. Priyanka Sawan	AAO
33.	Mr. S.P. Singh	Private Secretary
34.	Mr. Ravi Shankar	Assistant
35.	Mr. Avinash Kalanke	Assistant
36.	Mr. Anil Carrasco	Assistant
Technical Staff		
37.	Sh. Raghu Nath Singh	T-9 (CTO)
38.	Dr Nikhilesh Pandya	T-9 (CTO)
39.	Dr V.P.S. Bundela	T-9 (CTO)
40.	Mr. Sanjay K. Pandey	T-9 (CTO)
41.	Mr. Ramendra N. Shrivastava	T-9 (CTO) (till 30.09.2023)
42.	Mr. Devdatt N. Baraskar	T-9 (CTO) (till 30.04.2023)
43.	Mr. Shyam K. Verma	T-6 (ACTO)
44.	Mr. Om P. Vishwakarma	T-5 (T.O.)
45.	Mr. Rakesh C. Shakya	T-5 (T.O.)
46.	Mr. Irfanur R. Khan	T-5 (T.O.)
47.	Mr. Francis Damasus	T-5 (T.O.)
48.	Ms. Jyoti Meena	T-3 (T.A.)
49.	Mr. Bilbar Singh	T-2 (Sr. Tech.)
50.	Ms. Seema Chouhan	T-1

Skilled Supporting Staff		
51.	Mr. Sanjiv Mishra	Duplicating officer
52.	Mr. Nirbhay Singh	Skilled Supporting Staff
53.	Mr. Balbir Singh	Skilled Supporting Staff
54.	Mr. Surla	Skilled Supporting Staff (till 31.03.2023)
55.	Smt. Fulki Bai	Skilled Supporting Staff
56.	Smt. Raida Bai	Skilled Supporting Staff
57.	Shri Mangilal	Skilled Supporting Staff
58.	Smt. Kamli Bai	Skilled Supporting Staff
59.	Shri Deepak	Skilled Supporting Staff
60.	Smt. Chunki Bai	Skilled Supporting Staff
61.	Smt. Sagri Bai	Skilled Supporting Staff
62.	Smt. Sagar Bai	Skilled Supporting Staff
63.	Smt. Rekha Bai	Skilled Supporting Staff
64.	Smt. Meera Bai	Skilled Supporting Staff
65.	Smt. Parvati Bai	Skilled Supporting Staff
66.	Smt. Romu Bai	Skilled Supporting Staff
67.	Smt. Teju Bai	Skilled Supporting Staff
68.	Smt. Surja Bai	Skilled Supporting Staff
69.	Smt. Rumli Bai	Skilled Supporting Staff
70.	Smt. Sarita Bai	Skilled Supporting Staff
71.	Smt. Sangeeta Bai	Skilled Supporting Staff
72.	Smt. Hira Bai	Skilled Supporting Staff
73.	Smt. Antar Bai	Skilled Supporting Staff
74.	Smt. Mangi Bai	Skilled Supporting Staff
75.	Smt. Naki Bai	Skilled Supporting Staff
76.	Smt. Santo Bai	Skilled Supporting Staff

Joining, Promotions, Transfer, Retirement

Joining

1. Shri Somnath Mukharjee, joined as A.F.A.O. on 02.08.2023

Transfers

S.No.	Name of the employee	Post	Transferred to	Date of transfer
1	Dr. Rajkumar Ramteke	Principal Scientist	ICAR-CICR, Nagpur	23.03.2023
2	Dr. Nita Khandekar	Principal Scientist	ICAR-CIAE, Bhopal	28.03.2023
3	Dr. Manoj Shrivastava	Principal Scientist	ICAR-IISR, Lucknow	19.06.2023

Retirements

S.No.	Name of the employee	Post	Date of Retirement
1	Dr. D. N. Baraskar	CTO	30.04.2023
2	Shri Ramendra Nah Srivastava	CTO	30.09.2023
3	Shri Surla	Skilled Supporting Staff	31.03.2023

भा.कृ.अनु.प. – भारतीय सोयाबीन अनुसंधान संस्थान

ICAR – Indian Institute of Soybean Research

ISO 9001 2015 Certified Organization

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